

The Environmental Ethics of Domestication

when biotechnology reframes nature

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Declaration of Originality

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.


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1/12/08

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Abstract

Controversies about genetic engineering in agriculture mobilise the concept of nature in ways that reframe nature with significant conceptual implications for the field of environmental ethics.

The political economy and regulatory environment of genetic engineering excludes non-technical, non-expert and non-market perspectives in official assessments of biotechnological risk, but broader public conceptions of risk include philosophical concerns about the implications of genetic engineering for nature. Critical attention to the philosophical substance of these concerns is moderated by the conceptual ambiguity of their articulation in terms of unnaturalness and the ubiquity of other rhetorical appeals to nature as a source of precedence, legitimacy and morality. These discourses of naturalness are primarily concerned with whether genetic engineering represents a significant departure from conventional and traditional crop breeding practices or merely their continuation. This tension is seen in contrasting visions of biotechnology as either evolutionary or revolutionary and is resolved by recourse to particular narratives of domesticatory, evolutionary and cultural histories. Strong associations between traditional, conventional and biotechnological domestication cast the previously overlooked moral dimensions of domestication in relief. Protest against genetic engineering on philosophical grounds reinvigorates domesticated nature with positive natural values so that conventional domesticates appear more natural in comparison to genetically engineered plants. Biotechnology debates indicate that the moral dimension of domestication reaches a moral limit in genetic engineering and that both of these are subjects for environmental ethics.

The recasting of domesticates as natural effectively extends the nature that environmental ethics theorises and seeks to protect, and presents a challenge to the established perimeters of the field. Environmental ethics is, understandably, biased in favour of wild nature and has traditionally dealt with domesticated nature only incidentally or has omitted it from ethical consideration altogether. This has limited the scope and instructiveness of its contributions to biotechnology debates. The leading conceptual tools of environmental ethics require adaptation and expansion in order to meet the new political imperative to save domesticated nature from biotechnological intervention. An assessment of the value of the nature/artefact distinction for understanding the ontological status of both domesticates and genetically engineered plants is instructive, but ultimately encourages revision of the split between wild and domesticated nature. The development of a more nuanced environmental ethics appreciation of domestication as a human-centred use of nature comes through the recognition of the persistent wild characteristics of domesticated plants and the reframing of the domesticatory relationship in collaborative, coevolutionary terms.

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Introduction

Moral concern about the implications of biotechnology for nature has been a key element of public resistance to the use of genetic engineering in crop agriculture. The recombinant-DNA technique is regarded in these objections as an unnatural, unnecessary and unwelcome intervention that is morally problematic irrespective of its environmental consequences. Considered assessment of the philosophical and ethical import of these moral objections has been limited by the inherent power inequities in disputes about biotechnology and the persistent ambiguity of the concept of nature itself. The field of environmental ethics is well placed to decipher the significance of moral concerns about human interferences in nature, but has been restricted in this task by the traditional exclusion of domesticated nature from its theoretical scope. The primary aim of this thesis is to revise the parameters of the field to include domesticated nature, with a secondary aim of providing an environmental ethics appraisal of genetic engineering that accounts for the substance of public concerns.

This work is situated within environmental ethics literature but is prepared to gain insights from other fields in moving beyond dualistic approaches to understanding human-nature interactions. It develops a positive account of domesticated nature by identifying existing conceptual resources adaptable to the case of domesticated nature, and progressing these through synthesis with domestication scholarship from further afield. It critically reviews the nature/artefact and wild/domesticated ontologies to provide an understanding of domestication in relational terms.

The public debates about agricultural biotechnology provide the starting point for this work. Academic pronouncements of the end of 'nature' by way of the rejection of the nature/culture dichotomy have not been reflected in popular discourse, and the dividing line between society and nature has prevailed in these debates as a highly significant boundary whose perceived transgression is a hotly contended topic. Implicit and explicit claims about the 'naturalness' or otherwise of genetically engineered organisms have ontological implications for the discourses of value in nature that are still taking place within environmental ethics. Genetically engineered organisms present a point of comparison against which domesticated organisms appear natural, while civic concerns about naturalness mobilise environmental values in defending domesticated nature against biotechnological modification. This reframing of domesticated nature as nature proper in the popular imagination represents an empirical extension of what counts as nature that compels an environmental ethics response.

Environmental ethics has traditionally, and understandably, pursued a focus on wild nature to the relative exclusion of other landscapes. Domesticated nature, together with restored nature and the built environment, are the subaltern objects of environmental ethics. These entities feature in theories of value primarily in terms of the imperative to contain their potential impact on real nature. Genetic engineering, as an intensive technology that is designed to increase production while preventing further encroachment of agriculture into wild lands, is therefore an exemplary in-fill development. While environmental ethicists have previously provided in-principle arguments against such fine-grained interferences in wild nature as the installation of signs and timber handrails, their objections to biotechnology tend to shy away from deontological arguments. The conceptual resources originally developed to account for the value of wild nature are not easily applied to domesticated nature. They tend to reflect a broader commitment to dichotomous notions of nature and culture that regard the presence of culture as a loss for nature. As a discipline concerned with ascertaining and prescribing the morality of human relationships with nature, the existence of definitively natural and distinctly cultural processes is key to environmental ethics analyses. Where these processes are treated as purified, mutually exclusive categories, the capacity of environmental ethics to appreciate the variability of nature as it is influenced through its relations with humans is significantly limited.

Recent critical attention to domestication in the fields of geography, biology, animal studies, archaeology and bioethics encourages a similar contribution from environmental ethics. This scholarship revises the traditional narration of early and ongoing domestication as the triumph of culture over nature, underscores the role of nature and natural processes in domesticatory practice and products, and offers an appreciation of domestication as the outcome of ecologically intimate relationships between people and their food source. As would be expected, it shows a strong focus on animal domestication and the ethics of animal husbandry in the context of large scale industrial food production. This thesis, while interested in domestication *per se*, is specifically concerned with the domestication of food plants. A focus on animals would make best use of insights from domestication scholarship, but risks iterating well-worn arguments between animal welfare advocates and ecocentric ethicists about the irreconcilability of broad ecological concerns with individual animal interests. Plants are a more versatile subject matter. They are so biologically embedded in the agroecology that they collectively comprise the domesticated landscape, but they can also be regarded as individual organisms. Their easy handling, transport, and rapid breeding has seen their appropriation as genetic resources rather than organisms, and their subjection to intense political struggles for ownership and control. Further, while the moral dimensions of farming animals for food have long been visible, biotechnology brings the morality of

plant domestication to the fore for the first time. The under-theorisation of domesticated nature in environmental ethics – a significant gap in the field since its inception – is even more pronounced in the case of plants.

Extending the scope of environmental ethics to recognise and include domesticated nature is supported by calls from within the field for a more positive account of human relationships with nature. The sharp contrast between respect for wild nature and the pure instrumentality with which resourced nature is used disregards the worth of the less-than-wild nature that we encounter in everyday life. The value discontinuity between the nature that is devoid (as much as is possible) of cultural interference and that which is influenced and indeed co-produced by culture, implies that people can only have an ethical relationship with nature *in absentia*. Environmental ethics needs to offer more than this, not least because there is now no significant part of the planet that does not bear evidence of human activity. Approaching this problem through the framework of domestication allows for consideration of the wider social and political contexts of interventions in nature and secures the relevance of the analysis at a time when biotechnology debates are being eclipsed by the emergence of new molecular technologies that represent an even more radical revision of nature.

This thesis is structured in three parts, progressing from public debates about biotechnology to environmental ethics appraisals of genetic engineering to evaluations of current and potential conceptualisations of domestication and biotechnology. **Part One** presents a critical analysis of debates about biotechnology with attention to the significance of concepts of nature and naturalness. **Chapter One**, *Agricultural biotechnology: the environmental, social, and political debates*, situates moral concerns about the implications of biotechnology for nature within wider popular debates about genetic engineering in agriculture. It establishes that concerns about the conceptual and material integrity of nature are a prominent element of civic resistance to the technology and that the substance of these concerns warrants further consideration. Together with a public mistrust of regulatory stringency and corporate priorities, these moral concerns comprise a broader understanding of risk than is recognised in technical risk assessment processes. Public objection to biotechnology on this basis has been effectively marginalised by a regulatory bias that limits public participation in favour of expert scientific assessments, the lobbying power of transnational corporate interests, and a domestic pre-commitment to biotechnology that has been ratified in international trade and intellectual property agreements. The marginalisation and trivialisation of concerns about nature is also an effect of the general problem of weighting philosophical against practical considerations: these concerns are eclipsed by the seriousness of the attendant social, economic and political struggles.

A number of factors are shown to warrant the further examination of philosophical issues about nature. First, civic objections have constrained the progress of biotechnology in agricultural markets. Jurisdictions have adopted precautionary regulatory styles, product labelling requirements, moratoria and trade restrictions, while consumer unwillingness to purchase genetically engineered food has affected trends in research and development investment. Second, scientific uncertainty about the long term risks of genetic engineering, and the lack of accountability of corporations, justifies a more participative model of governance that would give these issues proper consideration. Third, these concerns and the minorative responses to them mobilise normative models of what nature is and how it ought to be used, which makes than a subject for scholarship on the concepts of nature and culture. This chapter concludes that there are practical, political and academic bases for evaluating the ethical significance of the substance of moral opposition to biotechnology.

Chapter Two, *Biotechnology reframes nature: discourses of naturalness and domestication*, provides an analysis of the key discourses of naturalness in biotechnology debates and details how these have affected consideration of the philosophical issues at stake. Ideas and ideals of nature are central themes in arguments for and against the technology, and both make appeals to nature as a source of moral legitimacy for their positions. This chapter identifies a repetition of the problems of logic and conceptual ambiguity that characterise any argument that makes recourse to nature for moral authority. The difficulty of differentiating matters of substance from loose rhetorical appeals is only heightened by the tendency to articulate popular concerns about nature in the dualistic terms of naturalness and unnaturalness. These conceptual limitations are particularly pointed in the case of domesticated nature, which has not traditionally counted as nature proper.

Discourses of naturalness and similarity that are employed by proponents of biotechnology in positive representations of genetic engineering generate a tension between evolutionary and revolutionary visions of biotechnology. These tend to be resolved by recourse to particular domesticatory, evolutionary and cultural narratives that emphasise the continuity of genetic engineering with previous domesticatory practices and evolutionary processes. These associations also rely on the conceptual reduction of biology to genetics through the recasting of natural history in purely genetic terms.

Biotechnology discourses reframe domesticated nature as nature. Moral objections to the technology are interpreted as an affirmation of the natural value of domesticated nature, an identification of a previously unrecognised moral dimension to the process of domestication, and a criticism of genetic engineering as representing the moral limit of this process. The field of environmental ethics, as the discipline concerned with theorising the morality of the

relationship of humans to the environment, is identified as best placed to appraise biotechnology and domestication with respect to natural value.

Part Two presents a comprehensive review of contributions from the field of environmental ethics to ethical assessments of domestication and genetic engineering. **Chapter Three**, *Environmental ethics on domestication: the place and status of domesticated nature*, assesses the established place of domesticated plants in environmental ethics theories of value. It identifies a neglect of domesticated nature associated with the original political imperative for the field to develop formulations to support the conservation of wild nature and its concomitant rejection of anthropocentric approaches. The status of domesticated nature is traced through intrinsic value theories that are concerned with the organism as a living being and as an autonomous entity, the species it belongs to and the ecological community of which it is a part. The chapter concludes that domesticated nature has either been explicitly excluded from moral consideration, or included to the limited extent that it resembles wild nature. Domestication is broadly considered a source of disvalue because it necessarily entails the instrumental use of nature, is a source of horticultural pollution in wild places, diminishes the autonomous status of nature, and is understood as the outcome of a process of domination.

This chapter identifies a strong ethical discontinuity at the boundary between wild and domesticated nature in environmental ethics scholarship. **Chapter Four**, *Environmental ethics on biotechnology: domestication revisited*, evaluates the impact of this split on environmental ethics contributions to biotechnology debates. It examines the range of conceptual approaches taken in environmental ethics critical appraisals of the technology and assesses how these revisit or revise the traditional standing of domesticated nature, and how they take account of the popular reframing of domesticated nature as valuable in the face of its biotechnological modification. Two attempts to incorporate domesticated nature into intrinsic value axiologies are reviewed, and a frequent objection to genetic engineering on the basis that it is an excessively instrumental relationship to nature is identified. The field's contributions to popular debates about naturalness and the crossing of species boundaries direct discussions toward the concepts of wildness and *telos*, but also tend to iterate similarity discourses that take domestication and evolution as naturalising precedents for future anthropogenic change. This chapter identifies three promising thematic areas of environmental ethics scholarship on biotechnology. The first is a return to questions of naturalness *via* an iteration of the nature/artefact ontology. The second is the prospect that domesticated nature possesses a retained wildness that is a source of natural value, and the third is a focus on the quality of the relationship of domestication. The in-depth treatment of these three thematic areas forms **Part Three** of the thesis.

Chapter Five, *Naturalness: artefactuality and the ontology of domestication*, is an assessment of whether domesticated nature can be categorised as artefactual or natural, and whether this ontology is an instructive basis for assessing the implications of genetic engineering for nature. Working through a series of definitions of artefactuality, it traces the role of human intentionality and artifice in agricultural origins and domesticatory history. Dependence on human intention is a key element in contemporary and Aristotelian conceptualisations of artefacts, which are further concerned with organic unity, reproduction, and the 'four causes' as they are affected by technological capacities. Against these criteria, domesticated nature proves difficult to definitively categorise: despite its excessive modification to the satisfaction of human desires, it retains its own biological tendencies and preferences, and these have been central to the creation of domesticated forms. The retained wildness of the domesticate resists its categorisation as an artefactual entity. This chapter concludes that the artefact/natural object ontology is limited in its instructiveness by the severity of these dualistic categories, and their inability to fully account for the recognition of natural value in those organisms that have started down the path of becoming artefactual.

The idea that domesticated nature retains a persistent wildness and that this can stand as its source of natural value has also been tentatively proposed in environmental ethics contributions to biotechnology debates. It is developed further in **Chapter Six, *Wildness: reconciling the wild/domesticated split***. The traditional mutual exclusivity of wildness and domestication is challenged by the recognition of three possible sources of retained wildness in domesticates. Following on from the separation of the quality of wildness from the place of wilderness, this chapter recognises the synonymy of wildness with the qualities of diversity, indeterminacy and otherness, and the retention of these qualities in domesticated nature. Each particular configuration of retained wildness under domestication is shown to provide both natural value and a foundation from which to critique agricultural biotechnology. Wildness and domestication are strongly imbricated and domestication does not supplant wildness in its entirety at every scale and scope. Wildness is retained in the phenotypic diversity of domesticated forms, in the indeterminacy of evolutionary processes as they are retained under domestication, and in the pervasive otherness of non-human nature. This chapter affirms the place of domesticated nature *qua* nature within the field of environmental ethics. It shows that theories of value that were developed for wild nature can be applied to domesticated nature and be used to inform the critical appraisal of the adoption of genetic engineering technology in agriculture.

Chapter Seven, *Relationship: toward a relational appreciation of domestication*, offers an argument for the conceptualisation of domestication in relational terms. The artefact/natural

object distinction is a static dichotomy that does not account for the persistent wild otherness of domesticated nature, or the possibility that the process of domestication might be mutually affective rather than a strictly one-way arrangement. Taking the lead from recent neo-Darwinian developments in domestication scholarship, this chapter departs from the traditional understanding of domestication as human-nature domination that underlies its treatment as a source of disvalue in environmental ethics, and presents domestication as a coevolutionary relationship.

The coevolutionary model is the next iteration of recognising otherness in domesticated nature. By emphasising the ecological context for domesticatory adaptations and the primacy of botanical form in domesticatory practices, it affirms the contribution of the other to the process and products of domestication. The resulting domesticate is a collaboration of human and plant intentions. This ontology does provide resistance to the further humanisation of nature, however. Objections to agricultural genetic engineering are defensible on relational grounds to the extent that they represent a protest against the entrenchment of excessively instrumental and coercive relationships with nature that preclude respect for nature *qua* the other.

The concluding chapter, *Domestication, biotechnology and the domus*, iterates the main themes of the thesis and looks to future directions for the further development of a relational appreciation of less-than-wild nature within environmental ethics.

Chapter One

Agricultural biotechnology: the environmental, social, and political debates

Introduction

The introduction of genetic engineering technology into agriculture has been the subject of a passionate and sustained global controversy. Although genetic engineering (also referred to in the abbreviated GE) has been a contentious topic since initial recombinant DNA experiments in the early 1970s – and arguably since it was first conceptualised – the civic response to GE in its early days was largely positive in comparison to the later debates¹. The global commercialisation of genetically engineered food crops and the subsequent appearance of unlabelled genetically engineered food on the market in the early to mid 1990s changed public reception and media representation of the technology significantly. Debate reached a peak in the late 1990s in a storm of media coverage, public protest and legislative activity that was punctuated by trade, environmental and scientific controversies, and the issues headlined then are yet to be resolved. With a high rate of commercialisation that has seen the global acreage of genetically engineered crops increase to 252 million in the 10 years to 2006 (James 2006), questions regarding the safety of genetically engineered food for human consumption and the potential risks that agricultural biotechnology may pose to the environment remain firmly on the public agenda, as do an array of social, political, economic, and philosophical issues about current and future impacts of biotechnology in agriculture.

Moral concerns about the ‘naturalness’ of biotechnology are a visible element of the broader public resistance to genetic engineering. These concerns are not levelled at the quantifiable environmental, economic or social consequences of biotechnology, but rest on the notion that there may be philosophical reasons to oppose its use in agriculture. This chapter establishes the real world context for the philosophical inquiry undertaken in subsequent chapters, and provides background on key issues and sites of controversy of genetic

¹ Early resistance to the technology began within scientific circles and was principally concerned with the effective containment of GE laboratory experiments. Before the debates of the late 1990s, there were notable cases of organised and effective civic resistance to the introduction of genetic engineering in both the United States and Australia (Wright 1986; Hindmarsh 2005).

engineering, with a geographical focus on Australia, the United States (US), the United Kingdom (UK), and Western Europe. It is not primarily concerned with explicating the detail of moral concerns about biotechnology and nature, but with establishing how the political and regulatory environment within which they are voiced has mediated the way they are articulated and received. There is a politics to the enactment of these concerns, which provides practical grounds for further examination of their philosophical substance.

Moral concerns about nature are frequently eclipsed by the volume, complexity and seriousness of the socio-political, socio-economic and techno-scientific issues at stake in this debate. Nonetheless, these concerns have been politically influential to the extent that they contribute to a consumer unwillingness to purchase genetically engineered foods. There are limited opportunities for public participation in determinations of genetic technology, and involvement in the debate is effectively restricted to people's roles as consumers in the marketplace. Consumer preference for non-genetically engineered foods has negatively impacted on market progress of the technology and motivated several moratoria on the approval of genetic engineered food crops for environmental release. Although resistance to genetic engineering has been significant, transgressing national borders and demographic groupings, and incorporating a range of protesting strategies, this chapter has a particularly focus on how concerns about nature have been enacted through the role of the consumer.

Such concerns are also bound up in conceptualisations of health and environmental risks that underlie civic scepticism about the benefits of genetic engineering. Formal risk assessment processes have a narrow scope that only accepts scientific evidence of measurable harm when assessing the commercial release of genetically modified organisms. Moral issues, particularly those identified by non-experts, are necessarily excluded from consideration. At the more general level, resistance to biotechnology is marginalised by a political economy of allegiances between governments and the powerful biotechnology industry and their combined strategy to promote the technology by influencing, rather than listening to, public opinion. The split between public and expert knowledge in the debate, and the regulatory bias in favour of expert, scientifically-informed estimations over public opinion, frames concerns about naturalness as the result of ignorance. These concerns are openly trivialised by pro-biotechnology actors, and frequently rejected by other critics of the technology who are keen to disassociate their own consequentialist arguments from in-principle opposition that is seen to undermine the credibility of resistance to GE. Issues of world hunger, participative governance, corporatisation and globalisation of food economies including the expansion of intellectual property regimes, and sustainable agriculture overshadow disputes about the conceptual implications of biotechnology.

Environmental debates relate primarily to competing claims about whether biotechnologically modified crops can realise the goal of sustainable agriculture and protect nature from chemical and genetic pollution, but ideals and ideographs of nature and naturalness permeate discussions about genetic engineering, and the idea of nature as well as its materiality is seen to be at risk. The scope and effect of the environmental values advanced on behalf of wild and domesticated nature through public concern about the naturalness of food, agriculture, and the products and techniques of genetic engineering compels further examination of the substance of these concerns.

The genetic engineering debate

Arguments over the benefits, costs, risks and desirability of agricultural biotechnology form a series of debates that are commonly referred to in the aggregate as ‘the genetic engineering debate’. The debate has differed in degree and scope in different countries over the last decade, though its intensity has depended largely on public responsiveness to GE foods. The US cultivates the largest acreage of genetically engineered crops² and the US public was relatively accepting of genetically modified foods³ compared to Continental Europe, which experienced significant public opposition and has since developed the most stringent regulatory requirements for GE food crops in the world. The UK, effectively positioned between the conflicting stances of Europe and the US, has hosted public debate and been a key site of radical protests such as the deliberate sabotage of GE field trials and the symbolic dumping of tonnes of GE soybeans at Downing Street steps. In New Zealand, opposition to the technology through public and non-government organisation (NGO) action led to a Royal Commission into genetically engineered food⁴. In Australia, the national call for consistent support for biotechnology was defied by all canola-growing states, which called moratoria on the growing of GE food crops until it is supported by consumers in the marketplace⁵ (Ludlow 2004). Probably the most controversial national action on genetic engineering was Zambia’s rejection of thousands of tonnes of GE corn in US food aid in

² 54.6 million hectares, or 54% of the total biotechnology acreage at 2006 (James 2006).

³ Although the US did have a latent popular movement against genetic engineering in the early days of the technology (Schurman & Munro 2006).

⁴ The Royal Commission ran for over 15 months in 2000-2001, and received over 10,000 submissions, of which 92% were opposed to GE. The Commission ultimately recommended to the NZ government that it “keep its options open”, lift its moratoria, and adopt a case-by case approach to the approval of genetically engineered crops (Ministry for the Environment 2003; Pollak 2003).

⁵ In November 2007, it was announced amid public controversy that the moratoria in New South Wales and Victoria were to be lifted (NSW Department of Primary Industries 2007; Rood 2007). They have remained in place in Western Australia and Tasmania, whose relevant ministers issued a joint statement that “[u]nless consumers tell us otherwise, [we] will not be changing [our] policy on GM food” (McDonald 2007). South Australia is currently considering a review of its moratoria (AAP 2007).

2002 on the grounds that it would contaminate their crops and was not safe for human health, even though nearly 3 million Zambian people were facing severe food shortages (Nielsen *et al.* 2003). Even countries that have embraced genetically engineered crops, such as Argentina – which has planted out the world’s second largest acreage of GE crops after the US – are affected by global (particularly European) consumer resistance to consuming genetically engineered food. Regardless of these significant differences in national interests and responses, the debate is inherently international: “[f]lora and fauna do not heed political boundaries, and neither does the food market” (Cook 2004: 5).

The debate is constituted by an array of interest groups and individuals, including governments, biotechnology companies, environmentalists, food retailers, non-government organisations, consumer groups, industry and non-industry scientists, First and Third world⁶ farmers, anti-globalisation groups, intellectuals and biotechnology critics, religious groups, and key public figures. It takes place through press releases, political speeches and proclamations, scientific and academic papers, educational resources, corporate transactions and industry public relations, government policy and legislation. Environmental NGOs and consumer groups have run dedicated campaigns against genetic engineering in food, providing educational shopping guides to avoid GE and advocating a ‘freeze’ on the commercial release of GE crops (ACF 2000; Genethics Network 2000; Greenpeace 2001b). The public expresses its resistance to the technology through protests, formal submission processes and their responses in numerous surveys, though the limited opportunities for public participation restrict effective involvement in the debate to people’s roles as consumers in the marketplace, rather than as citizens in a democracy (Davison *et al.* 1997). Some industrial farmers have joined together to oppose the technology because of its cost ineffectiveness and its anticipated underperformance in the world market (Network of Concerned Farmers 2004). Third world farmers’ networks, development NGOs and anti-globalisation groups have protested the concentration of economic and indeed political power over the food chain in the hands of a few large biotechnology corporations (for example, ANGOC 2001), while non-industry scientists have publicly challenged the environmental and health safety of GE crops. Some of these protests may not be unique to the context of genetic engineering (Kline 1991; Berkhout 2002) for instance, resistance to the concentration of economic and political power in the hands of a few biotechnology

⁶ The terms First world and Third world – also referred to as North and South or ‘core’ and ‘periphery’ – are used to describe the geographically disproportionate pattern and concentration of economic benefits in the global economy. The uneven development of regions is seen in income rates, trade flows, capital flows, and economic output. Given that there also exists an uneven distribution of wealth and income *within* regions, these descriptive terms are not unproblematic (Smith 1999).

corporations borrows its agenda from the broader anti-globalisation movement (Smith 1999).

Although these issues are complex and wide-ranging, affecting a range of different parties on different fronts, the debate tends to be presented as a highly polarised argument between those in favour of the technology and those against it, “with [the] two sides holding incompatible, diametrically opposed views” (Adam 2000: 130). Biotechnology Australia (BA) – the Australian government body established to fund, advocate and conduct public research and education for the local biotechnology industry – notes that “[u]nfortunately, discussions on gene technology tend to be polarised into single arguments, for or against”, which stops people from accessing “the full facts and arguments to help them make more informed decisions” (Cormick 2004: 1). Ironically, the BA website ‘fact sheet’ that readers are directed to in order to remedy this problem is titled *Arguments For and Against Genetic Modification*, which is not unexpectedly a little heavier on the ‘For’ (BA 2004). In truth, resistance to biotechnology ranges from outright opposition to sceptical caution, and proponents from keen promotion to wary approval. ‘Opponents’ and ‘proponents’ are not homogenous groups, but distinct and disparate collections with different motivations and levels of enthusiasm⁷ (Hindmarsh & Lawrence 2001). Some are broadly accepting of genetic engineering, while others advise caution and wish to determine acceptance or rejection on a case-by-case basis (see Reiss & Straughan 1996). Resistance may relate only to specific applications of GM technology, or the manner in which risks are being assessed, without necessarily reflecting a disagreement with genetic engineering in principle. The identification of polarisation in the debate, then, also refers to its atmosphere of mistrust in which motivations are doubted on both sides. Typically, the ‘opposing’ public is cast as ignorant and irrational, while proponents of the technology are suspected of protecting vested profitable interests or advancing an ideology of progress at any cost. Thus polarisation also runs along education lines⁸, with governments and industry representatives keen to diagnose public unacceptance of GE foods as the result of scientific ignorance. The concerns of the public are clearly delineated from those of experts, and regulatory systems that are structured to consider exclusively technical accounts of risk are not able to respond to the substance of moral and non-scientific concerns (Purdue 1995; Anderson 2001; Turner 2001).

⁷ The true heterogony of these positions has lead Klintmann (2002) to classify participants in the debates not as proponents and opponents but as representing particular alliances.

⁸ Biotechnology Australia’s ‘fact sheet’ presents arguments *against* genetic engineering in informal language, with short, abbreviated words and interrogatives ending with a question mark, and arguments *for* the technology in proper paragraphs with formal language.

Consumer resistance to genetic engineering

A central element of this controversy is a widespread consumer unwillingness to purchase or eat genetically engineered foods. Soybean, corn and canola genetically engineered for herbicide and/or pest resistance have been commercially grown, marketed and sold on domestic and then global markets since 1995 (James 2006). A clearly labelled and price-competitive tomato puree⁹, made from tomato that was genetically engineered for processing rather than fresh sale, sold successfully in the UK from 1996 for three years before a wave of consumer resistance, which was linked to revelation of the sale of unlabelled and unsegregated US genetically engineered soybeans on the European Union market, saw its removal from the shelves by retailers (Harvey 1999). The rise of consumer resistance in Australia was similarly linked to the revelation in the late 1990s that supermarkets were selling unlabelled imported genetically engineered food products (Bonfiglioli 2002).

Consumer aversion to GE food cuts across issues of food labelling, food safety and questions about the adequacy of regulatory mechanisms. A majority of consumers across jurisdictions favour compulsory and comprehensive labelling regimes for the food products derived from genetically engineered plants¹⁰ (Campbell *et al* 2000; Bender & Westgren 2001; Bruce 2002b; Beckwith *et al.* 2003; Cooley 2004; Qvist *et al.* 2006). Industry argues that this would entail prohibitive costs, while regulatory bodies cite either the difficulty of fully accounting for food purity given the global processing and transport chain¹¹ or, in the US particularly, the needlessness of labels given that foods derived from genetically engineered crops are deemed to be ‘substantially equivalent’ to conventional foods. The notion of ‘substantial equivalence’, simply that “the GM crop and its conventional counterpart are the same in terms of particular compositional variants (eg nutrients and toxicants)” (Herrick 2005: 288), does not support the costly process of grain segregation and traceability that is necessary for accurate labelling (Condon 2001; Lezuan 2006). Neither does the logistics of traditional large volume grain supply chains (Bender & Westgren

⁹ Developed by Zeneca (now AstraZeneca). The first biotechnologically produced fresh fruit or vegetable was the Flavr Savr™ tomato developed by Calgene (now Monsanto) for longer shelf-life to better meet the food industry requirement for withstanding long transport and storage processes. It was first sold in the US in 1996 but for price, quality and other market reasons unrelated to its genetic modification, was a commercial failure in under a year (Martineau 2001; Soil Association 2005).

¹⁰ 85% of the US public want to know if genetically engineered ingredients are in their foodstuffs (Cooley 2004); and ANZFA consultations with stakeholders show overwhelming support for mandatory labelling (in Alexandra 2001).

¹¹ In 2001 the Australian and New Zealand Food Authority (ANZFA) introduced the requirement to identify genetically modified ingredients on the ingredients label for processed foodstuffs only where the novel DNA or its protein is still present in the final food or where the food itself has altered characteristics because of the modification. It allows for a 1% tolerance level and exempts non-packaged food sold at outlets for immediate consumption (ANZFRMC 2003).

2001). Rather than having to develop another system of physical separation, supervision and testing, the commodity market would tend to resolve the problem of market identity through the reclassification of all conventional goods as “genetically engineered”. A similar problem exists in assuring the separation of genetically engineered from conventional (and even organic) field crops given their geographic proximity in the open landscape (Kinnear 2000; Qvist *et al.* 2006). Yet segregation and labelling is the principal means by which consumer resistance, through commercial boycotts, can be enacted¹².

In the absence of strong programs of public input into the adoption of new technologies (Frewer 1999; Dietrich & Schibeci 2003) and in alliance with the rise of the ‘organised voice’ of public interest organisations (Light *et al.* 2003), the consumer boycott is not a frivolous reaction but a political act (Goodman & DuPuis 2002). The assumption that the way the public can have voice in the debate about genetically engineered foods is to shop ‘GE-free’ (Greenpeace 2001a, 2001b) is the basis of organised campaigns of resistance. These have led to some state governments in Australia declaring moratoria on the growing of genetically engineered food crops (Tasmanian Department of Primary Industries and Water 2003; Lynch 2005). One commentator (Cooley 2004: 354) has even suggested that the extent of global consumer unwillingness not only counts in favour of labelling but works against the opening of global markets to GE foods on free market logic as “disrespect[ing] market members’ autonomy”. As it is, the biotechnology industry must at least be seen to respond to consumer concerns in order to establish a market for their goods (Walsh 2002). In the burgeoning politics of food, where consumers have “become reflexive, interrogating industry claims and refusing a passive role in the food system” (Goodman & DuPuis 2002: 19), the consumer is gaining agency¹³.

Although it has been argued that people’s moral right to exercise choice over what they eat is retained irrespective of what scientific knowledge might say about the safety of such foods (Thompson 1997b, 2002), the call for labels is underpinned by a sense of uncertainty about the possible health effects of GE food. Proponents of biotechnology in agriculture are united in the claim that there are no risks to human health. However, fears about food safety persist, and reviews of the available literature on food safety shows that there may not yet be sufficient information available to ensure this (Clark & Lehman 2001; Hindmarsh 2008). The prospect that the transfer of genes from allergenic foods into otherwise harmless plants

¹² In lieu of satisfactory labelling, Greenpeace (2001b) has developed a ‘true food’ guide for consumers to differentiate genetically engineered from conventional products.

¹³ At the height of the debate in Australia, the activist Australian GeneEthics network formed an alliance with the Australian Consumers Association rather than with environmentalist groups: being a consumer is more effective than an environmentalist or, indeed, a citizen (Dietrich & Schibeci 2003).

may make them allergenic in turn is a common concern¹⁴. Similarly, inserting genes from other species may give rise to the development of new toxins in food-bearing plants. Following a high profile UK controversy of 1998-9 over the scientific validity of the ill-health effects on rats fed genetically modified potatoes¹⁵, the possibility of unknown and long term health effects and the untrustworthiness of industry-sponsored science became legitimate risks, particularly in the wake of the bovine spongiform encephalopathy (BSE) crisis (Munnichs 2004). Other health concerns centre upon whether horizontal gene transfer in the human gut is possible, and if so, whether the antibiotic resistant trait of genetically engineered plants (antibiotic resistance is used as a marker gene to identify which plants have taken up the modification) can be transferred, which would significantly reduce the effectiveness of antibiotic drugs. For proponents, the lack of conclusive evidence is not a result of a lack of data but attests to the adequacy of the current regulatory regime, as well as the continuation of experimental and technology-refining research (Pascalev 2003). On top of such assurances, consumer health concerns are trivialised in the frequent reminder that all food eating is risky¹⁶.

The role of consumers in the debate must be considered within the broader policy tendency to position the public as lay consumers with none of the knowledge, rationality, or political right to participate that is possessed by experts (Turner 2001). Regulatory systems of risk assessment typically work with an exclusively technical definition of risk that limits involvement in risk assessment procedures to qualified persons with scientific expertise. Where ethical questions are addressed, they are disengaged from risk assessment proper and are resolved by specially established committees¹⁷: “[t]hus the state separates ‘risk’ and ‘ethics’, while assigning both realms to specialists” (Levidow & Carr 1997: 29). The broader normative conception of risk that is articulated by the public is not only concerned with the likelihood of scientifically measurable harm but also the impacts on social and political justice and the consolidation of inequitable economic power, as well as philosophical concerns about deep interventions into other life forms (Anderson 2001;

¹⁴ The discovery of a Brazil nut allergen in transgenic soybeans in the course of laboratory testing in 1996 stopped their commercial release—although they were not destined for human consumption—and brought the possibility of heightened allergenicity to prominence (Nordlee *et al.* 1996).

¹⁵ Authoring scientist Arpad Pusztai reported in a television interview that the rats had stunted growth and immune deficiencies prior to the release of his findings in a peer-reviewed article. He was discredited by peers and consequentially dismissed by his employer (Pusztai 2000; Bowring 2002; Scott 2003).

¹⁶ For instance, “[t]here is no such thing as safe food, and there never has been!” (Prakash 2001: 12); even though classical plant breeding has introduced very few deleterious genes from wild relatives to crops (Gepts 2002).

¹⁷ In Australia, the *Gene Technology Act 2000* [Cth] overwhelmingly favours scientific and technical assessment. Of the three advisory committees established by the Act, only the input of the technical advisory committee must be sought in approving the intentional release of genetically engineered organisms; theoretically, the specialist ethics and lay community committees may never be consulted.

Fraser 2001; Robins 2006). It also incorporates scepticism about the trustworthiness of experts and regulatory science to adequately account for all the technical risks¹⁸. The public response to biotechnology is often studied as an exemplar of Ulrich Beck's (1992) 'risk society'¹⁹. Social perceptions of risk diverge from official definitions, and public concerns are rooted in direct experience of the 'unknown and unintended consequences' (Beck 1992: 22) of modernity and the failure of regulatory science to stop invisible pollutants that have proved hazardous, such as pesticides, asbestos, uranium and 'mad cow' disease. Within this framework, consumer resistance to biotechnology is largely based on the evaluation that genetically engineered food is too risky and does not deliver benefits that are commensurate with this risk (Frewer *et al.* 1998; Cooley 2002).

The types of GE crops that are currently grown commercially are those that offer increased production efficiencies by reducing agricultural inputs and delivering a higher yield through pest and/or weed control characteristics. The agronomic traits of herbicide and insect resistance have been genetically engineered into the major food crops of soybean, corn (maize) and canola²⁰. These kinds of crops (known as 'first generation') are designed to benefit the farmer (Nuffield Council on Bioethics 1999; Wilkinson 2002) and, through the yearly purchase of seeds and compulsory agrochemicals, the biotechnology corporation²¹: "[v]ery reasonably, people asked why they should accept foods that might carry an imposed risk, which they did not need, which offered no tangible benefits to them, and which served only the corporate ambitions of powerful foreign companies" (Bruce 2002b: 285). Although cost savings could be cited as a consumer benefit of lowered production costs, when unknown food risks are considered to be high, cost reduction is perceived as less important (Bredahl *et al.* 1998; Wansink & Kim 2001; Gaskell *et al.* 2006). Certainly biotechnology food producers have not emphasised this point but instead have pointed to future traits that will be engineered into what are termed 'second' or more likely 'third' generation food crops that will benefit consumers through improved taste, increased longevity and superior nutrition. The realisation of these innovations in the marketplace is considered to be

¹⁸ In 2005 (well after the late 1990s peak of the genetic engineering controversy) 25.3% of surveyed Australians did not trust the Food Standards Australia New Zealand (FSANZ) and 27.6% did not trust the Office for the Gene Technology Regulator (OGTR) (BA 2005).

¹⁹ Beck's risk society is often adopted as a general framework for understanding genetically engineered crops as a contemporary risk (for example, Walls *et al.* 2005; Meyer *et al.* 2005; Miller 2003; Dietrich & Schibeci 2003; Robins 2006). See also Adam (1999, 2000) for an incorporation of Beck's hazard potential into a timescape perspective; Carr & Levidow's (2000) application of Beck's boundary testing questions to the case of genetically modified crops and Levidow & Carr (1997) on the implicit ethics of accounts of risk; and Qvist *et al.* (2006) on the coexistence of genetically modified and conventional crops.

²⁰ Herbicide resistance accounts for 71% of global GE crops, insect resistance for 18%, and "stacked" genes, or a combination of both traits, for 11% (ISAAA 2005).

²¹ There is also a link between the development of these crops with these traits, and the increasing financial relationship between university research and industry (Welsh & Glenna 2006).

achievable (that is, economically viable) only if consumers are willing to accept first generation biotechnology products (Bender & Westgren 2001; Burkhardt 2001).

Interestingly, medical biotechnology, or 'red biotechnology' to agriculture's 'green biotechnology', has received a general level of public acceptance (Frewer & Shepard 1995; Davison *et al.* 1997; Moon & Balasubramanian 2001). The development of medical interventions that can save lives and contribute considerably to improved quality of life for people suffering debilitating illnesses has a significant moral imperative that the development of biotechnological crops does not. It is generally agreed that human disease is an aberration requiring treatment, but the same is not thought about inefficiencies in food production (Bruce 2002b). From the consumer perspective, food is not 'broken' in that it does not require 'fixing' like a diseased or debilitated body, so artificial interventions are less justifiable. People are prepared to accept certain medical risks in exchange for substantial health benefits, but adding risks to the everyday consumption of food is unnecessary when there are no corresponding consumer benefits.

Aside from health considerations, consumers also make decisions about what they eat on the basis of food's invisible yet tangible qualities (Goga & Clementi 2002; Miles *et al.* 2006; Roe 2006). A person's relationship to their food is particularly intimate and a number of personal and cultural elements go into determining a thing as edible. Baby carrots may be judged to contain fewer vitamins from receiving less sunshine in their short lives, while organic carrots may be thought to contain more trace elements and is consumed accordingly. "Food is more than metabolic fuel. It has physiological, psychological, social, cultural and aesthetic associations ... The contribution of any food toward an individual's well being is as complex as the individual himself" (Goga & Clementi 2002: 312). While in an ideal world taste and wholesomeness coincide (Appelbaum 2002), in the context of modern food risks that are undetectable by the normal senses (Adam 1999) this kind of food sensibility is often articulated as a preference for naturalness, which is significantly stronger for food than it is for medicine (Rozin *et al.* 2004).

The 'unnaturalness' objection to genetic engineering

A fundamental appreciation of food as already (naturally) satisfactory underlies the frequency with which genetic engineering is described as unnatural in various opposition campaign materials (ACF 2000; Greenpeace 2001a) and is registered in public surveys (Lee *et al.* 1985; Hoban & Kendell 1993; INRA 2000; Kamalden & Powell 2005; Gaskell *et al.* 2006; BA 2008; see also Cook *et al.* 2004; Streiffer & Hedemann 2005). On average, just under a quarter of all genetics coverage contains references to 'nature', while media coverage of concerns about nature tends to be letters to the editor rather than articles

(Hansen 2006). The claim that genetic engineering is unnatural is now so prevalent that resistance to genetic engineering on these grounds has been shown in sociological research to reflect a social norm (Fleming *et al.* 2007).

The consumer preference for food naturalness is one that has been deliberately encouraged by the associations made between goodness and naturalness in the marketing of food and food products²² (Hansen 1991; Goodman & DuPuis 2002; Wilkinson 2002; Karafyllis 2003; Sagoff 2003). Claims about the ‘unnaturalness’ of biotechnologically produced food are unsurprising given the ubiquity of such associations: genetic engineering “in name and in concept ... belies the image of nature or of the natural to which the food industry constantly and conspicuously appeals” (Sagoff 2003: 11). Massive and unpredicted growth rates in the organic food sector over the last 10 years (RIRDC 2001; Lockie 2002, Lockie *et al.* 2002) also attest to the consumer importance of naturalness in food, and the preference for quality over the cheaper prices made possible by Fordist production methods (Wilkinson 2002) that forms part of the countermovement against the globally mobile corporate agribusiness sector (McMichael 2000).

The claim that biotechnology is unnatural is most visibly linked to dramatic rejections of genetically engineered food as ‘monstrous’ – frequently expressed through its description as Frankenstein food, or ‘Frankenfood’²³. Central to the Frankenstein literary metaphor is the repugnance or ‘yuk factor’ (Midgley 2000) of crossing species boundaries. Here, the genetically engineered food plant is considered unnatural because it contains mixtures of traits and characteristics from other organisms that would never have occurred in nature. This is deemed undesirable in itself, and is also seen to increase the likelihood of unknown health and environmental risks. Like Frankenstein’s monster, genetically engineered plants may prove dangerous beyond our expectations (Ho & Cummins 2000).

Common refutations of such concerns point to the scientific uncertainty that surrounds species concepts and cite evidence that gene transfer between species does in fact take place in nature *via* bacterial vectors (see Robert & Baylis 2003). Through evolutionary time, species are not fixed, immutable entities, but fluid, evolving and temporary organisations of genetic material. Support for the moral significance of crossing species boundaries questions the methodological validity of moving from a conceptual difficulty in defining species to their having no reality whatsoever (Zwanziger 2003), and entails a protest against the

²² The perceived naturalness of food is not necessarily connected by consumers to the agricultural field and the agroecology, as it usually is an expression of concern about food additives and other post-harvest processing (Verhoog *et al.* 2003).

²³ There is a noted lack of metaphorical resources available for GE and this limits the rhetorical scope of discourse on GE food to only a few literary references. It relies mainly on alliteration and plays on common phrases for effect; for instance, *seeds of disaster*, *seeds of dissent*, *seeds of doubt* (Nerlich *et al.* 2000).

seemingly sudden transformation of the complex individuated natural world into undifferentiated and manipulable matter. Thus, crossing species barriers “is unnatural in the quite plain sense that that it calls on us to alter radically our whole conception of nature” (Midgley 2000: 12). The religious equivalent of moral concern about interference with nature is the commonly encountered sentiment that to genetically engineer is to ‘play God’ (Evans 2001; de Castro & Alvarez 2002). On this basis, organic farming advocate Prince Charles (1998: 252) believes “that this kind of genetic modification takes mankind (*sic*) into realms that belong to God and God alone”. Humans may well engage in selective breeding and other programs of intervention to produce domesticates that are more to their liking, but they owe a level of respect to nature as the original blueprint of God’s design²⁴.

These objections form a category of concerns in which genetic engineering is seen to represent some kind of an affront to nature. It challenges core ethical principles of humanity because it distorts and instrumentalises nature and life and undermines both the integrity of nature and the sacredness of life. Pakulski & Trantner (2004) have identified this position as a new kind of environmental concern. They have labelled it ‘white environmentalism’, in keeping with the previous divisions of environmentalism as either ‘green’ (relating to concerns about the conservation of wild areas) or ‘brown’ (relating to concerns about pollution)²⁵. Initially, environmentalist responses to biotechnology were able to be represented through the existing language of ‘green’ and ‘brown’ environmentalism, but there soon emerged a new, ‘white’ environmental sensibility – the public concern with risks of human ‘interference with nature’ and the moral implications of biotechnology for ‘life’ and ‘humanity’ (Pakulski *et al.* 1998; Pakulski & Trantner 2004). These are moral concerns rather than physical concerns about measurable environmental harm, and are also strongly influenced by a critical view of the political economy of genetic engineering. Biotechnology, at once intrusive upon nature and wholly driven by very large profit-oriented multinational corporations, is perceived as ecologically risky and consequently opposed (Pakulski & Trantner 2004).

As a key element of consumer resistance, these intrinsic objections to biotechnological interventions in nature have political import (Streiffer & Hedemann 2005). Public unwillingness to accept biotechnologically produced foods on these grounds, or in direct

²⁴ See Chapter Two for detailed discussion on the different meanings of natural as it is used in debates about biotechnology.

²⁵ The colour schema of this ordering is self-evident: ‘green’ refers to tracts of wilderness, ‘brown’ to the literal and figurative dirtiness of pollution, and ‘white’ to the laboratory coats of bioscientists. According to Pakulski and Trantner’s (2004) sociological study, white environmentalists (also termed ‘conscience environmentalists’) are a socially diffuse grouping, typically new to expressing environmental concerns and not likely to be members of an environmental or political organisation.

protest of its social and economic consequences, has typically been framed by governments and industry as the twin result of scientific illiteracy and the inflammatory influence of anti-biotechnology NGOs (see Ruibal-Mendieta & Lints 1998; Trewavas & Leaver 2001; Styles 2002; Cook 2004; Jones 2004; Hindmarsh 2005). This model of public opposition as the result of ‘cognitive deficiency’ (Davison *et al.* 1997; Pfister *et al.* 2000; Dietrich & Schibeci 2003; Sturgis & Allum 2004) has informed the public relations and promotions strategy of scientific education programs and public access to pro-biotechnology experts in workshops and other forums that are predominantly levelled at redressing the public understanding of genetically engineered food as somehow unnatural (Braun 2002). But contrary to the assumptions of this model, data from public surveys and other research tools do not indicate a clear association between the perception of genetically engineered foods as risky and a lack of scientific knowledge (Poortinga 2005). Public understanding of science is also greater than is assumed by experts (Frewer *et al.* 1998), and the UK and Australian governments’ approaches to changing negative public opinion through scientific education have not been successful (Purdue 1995; Styles 2002), with some studies even showing an increased resistance to the technology after attendance at such education workshops (Frewer *et al.* 1998).

Such education strategies maintain the split between public and expert, treating the public (as consumers) as a homogenous grouping, and targeting the ‘innocent public’ over activists and the ‘interested public’ (Dietrich & Schibeci 2003) who are seen to have captured the public debate (Irwin 2006). Where political leaders do acknowledge that people oppose gene technology, they not only see these ‘concerns’ as stemming from ‘worry’ rather than ‘serious evidence’, but as carefully delineated from ‘true opposition’ (Cook 2004). UK Prime Minister Tony Blair’s 2001 speech on genetic modification intimates that “[o]n the one hand there are rational, progressive, well-informed and ‘serious’ thinkers like himself; on the other, there are ‘protesters.’ Torn between the two are ‘people’ who worry, understandably but wrongly, and do not know which way to turn” (Cook 2004: 19). This separation of the radical protesters from the misinformed public “denies the possibility that there might also be rational and informed opposition, with views based upon considered reflection” (Cook 2004: 19).

Pro-biotechnological arguments trivialise resistance as the emotional whims of consumers in industrialised nations as compared with the plight of starving people in less developed nations. The moral imperative to feed the world’s malnourished and starving populations by increasing yield through biotechnological advances is on par with the medical imperative to

save lives or dramatically improve their quality²⁶. Thus, “[t]he possibility that GM crops could make a substantial contribution to providing sufficient food for an expanding world is, on its own, a solid reason for engaging in the research that underlies their development” (Nuffield Council on Bioethics 1999: 3). The risks are simply outweighed by the benefits; any other concerns about the morality of genetic engineering are merely peripheral: “[t]he implicit claim is that the ‘good’ of feeding the hungry is surely warrant enough to eliminate any further need for ethical inquiry” (Westra 1998: 79; Bender & Westgren 2001). The moral legitimacy that addressing world hunger lends to the biotechnological project is supplemented by the accompanying imperative to do so sustainably. In an article that outlined ‘how genetic engineering will save our planet’ Monsanto CEO, Robert Shapiro, presented three possible responses to world hunger (Shapiro, in Smith 1999). The first was to effectively ignore it, the second was to increase agricultural yield through conventional industrial chemical methods and by putting more land over to food production, while the third was to increase agricultural yield within the framework of sustainable agriculture. Biotechnology was argued to be the only method capable of realising this third option.

World hunger and biotechnology

There are 800 million people in the world who do not have adequate food, and the population in geographical areas of food shortage is increasing (Parry *et al.* 2005). Proponents of biotechnology argue that the genetic engineering of food crops will increase yields and allow agriculturally marginal lands to be more productively cultivated; it is the only way to feed the hungry. Critics of the biotechnological solution point out that causes of hunger are complex, and that there is ample food produced in the world, but access to it is determined by economic modes of distribution (Jordan 2002). The Food and Agriculture Organisation (FAO) estimates that 2,780 calories are produced in the world per person per day and the adult daily need is only 2,350 calories (in Peters, CJ. 2000). Wealthy countries routinely throw excess food goods away. In the year 2000, the number of obese people in the world equalled the number of malnourished (Bowring 2002). Importantly, countries in famine often have food surpluses that are nonetheless exported as cash crops (Meadows 2000; Pilcher 2006).

²⁶ Excepting Garrett Hardin’s (1989) provocative observation that if increased food does reach the hungry and reduce suffering and death from hunger, it will also result in increased world population, which will, in turn, also need access to adequate food. Hardin points out that, given that biotechnology may well reach its own Malthusian limit, the number of people who suffer and die from hunger in the future will be greater than it is now. In the utilitarian equation where the goal of biotechnology is to reduce total suffering from hunger, it would thus be morally preferable *not* to increase production in the present day so that fewer people overall will suffer, until such time as we are technologically assured of meeting near infinite food demands.

The argument about hunger is difficult to reconcile because it relies on differing principles of justice that underlie different moral theories of social and economic distribution (Cooley *et al.* 2004). Proponents for biotechnology as the solution to hunger adhere to the principles of capitalism – and, more specifically, to the neoliberal model of globalisation²⁷ – where benefits should accrue according to a person's contribution. As biotechnology will allow more farmers to produce more food, they will contribute more to the capitalist economy and accordingly they will gain income benefits with which to then buy their own food. 'Food security' is achieved by improving the economic resources of people and the legitimacy of genetic engineering is thus measured against the extent to which it can boost production, improve rural incomes, stimulate growth in the rest of the economy, lower the prices of food, and increase purchasing power.

In the counter argument, benefits should be distributed according to a person's need and burdens according to a person's ability to bear them. The already ample amounts of food in the world should be redistributed according to need, particularly as this places little to no burden on others for whom the excess food is simply waste: "growing more food only solves the problem of hunger if the hungry eat that food" (Fowler & Mooney 1990: 59). This argument also stands as a critique of inherited systems of unfair distribution that are currently maintained by the trade mechanisms of the agricultural global market (Smith 1999). Defenders of biotechnology are routinely criticised for presenting the solution to hunger "in terms that tend to essentialize poverty and hunger as inevitable symptoms of a human condition, rather than to understand them through the lens of specific colonial and postcolonial histories" (François 2003: 43). In this view, a program of increased production will see poor countries unable to compete with cheap imports from wealthier nations, leading to increased landlessness and urbanisation, rising unemployment, and a worsening, not easing, of poverty (Shiva 1995; Smith 1999; Shiva 2000b; Mariano 2001; Bowring 2002). 'Food security' does not offer unmediated access to food, but money in the pocket; it is described by the biotechnology firm Cargill as "not a physical question of supplies but an economic issue of productivity" (Huber 1997, in Kneen 1999: 162). The crops grown by successful biotechnology farmers are not for local consumption, but for export markets (DFAT 1996). The main focus of crop biotechnology has been on food crops that are economically important in the North, where increased productivity will out-compete small rural farmers in the South and reduce the need to import Southern produce (Smith 1999).

²⁷ Globalisation is a problematised term, and in this context denotes the following 'interconnected phenomena': "the tremendous increase in the velocity and scale of money flowing through global circuits of financial capital; the extension of production chains across national borders through subcontracting; foreign direct investment in enterprises; and the increasing flows of goods and services in cross-border trade" (Smith 1999: 220). These are

The development by Calgene (now owned by Monsanto) of a canola plant that yields oil containing lauric acid, previously only found in coconut oils, is likely to replace the need to import coconuts for oil, yet almost one third of the population in the Philippines is employed in providing the export of coconuts (Mannion 1998; Smith 1999). The replacement of food goods that have traditionally been imported from the South with synthetically and biotechnologically produced substitutes will have a massive dislocating effect on those economies and livelihoods (Nuffield Council on Bioethics 1999; Bowring 2002). The neoliberal formulation of 'food security' requires a move away from subsistence to cash cropping (Smith 1999), while the competing concept of 'food sovereignty' would see a greater focus on retaining and enhancing local and domestic staple food production (Shiva 2000b).

Both critics and supporters of biotechnology have likened it to a second green revolution. In critical assessments, comparisons have been made between the new technology of genetic engineering and the green revolution in terms of the effects that the technology might have on Third World farmers' incomes²⁸. The green revolution received widespread support for its articulated mission to combat hunger through increased production, but packages of grain crops that were made available to farmers relied on extensive loan schemes and technological interventions that favoured the large-scale grower (George 1986). In effect, this exacerbated the gap between rich and poor farmers. Green revolution high yield varieties were more accurately high-response varieties in that they relied on fertilisers, irrigation systems, herbicide and pesticide applications (Perelman 1977; Fowler & Mooney 1990; Peters, CJ. 2000; Levidow 2001) and did not grow well for the poorer small-lot farmers who could not afford to buy either these inputs or the expensive food that they produced. To grow green revolution crops, farmers had to abandon their crop rotations systems that had periodically renewed soil productivity (Shiva 1991). Similarly, the adoption of transgenic corn crops has seen the loss of nitrogen fixing legumes in rotations, while its high fertiliser needs have proved too expensive (Kloppenborg & Burrows 1996). Genetic engineering can only benefit farmers if it is designed specifically to address their situations (Peters, CJ 2000; McAfee 2004). For example, the trait of grain non-spoilage, unnecessary to wealthy farmers who are equipped with adequate storage systems, would be beneficial for poor farmers who suffer post-harvest loss. In the poorest areas, existing

sanctioned and formalised by various world agreements on trade and have given rise to large multinational corporations as centres of power.

²⁸ For critiques of the green revolution see Perelman 1977; Shiva 1991; Bowring 2002. The green revolution also established the channels and precedent for agricultural 'technology transfer' from First to Third world countries: "It is the cultural text of the green revolution that has 'allowed entry' of GE into agriculture" (Rogers-Hayden 2000).

technologies such as fertilisers are yet to be effectively applied, and these and other low-input technologies (OFA 2001; Bowring 2002) may prove to be more beneficial than biotechnology, while infrastructure such as roads to get higher yields to market remains limited. Thus, “[s]o long as the success of this technology on the free-market is more important than the successful application of this technology toward world problems, genetic engineering will fail to help those most in need” (Peters, CJ 2000: 324). One biotechnology development funded by charitable and public sources that is used as the “paradigm [case] of positive benefits from the technology” (Bruce 2002b: 286) is Vitamin A rice. This rice is engineered to contain beta carotene and is designed to be grown where rice is the staple food and where malnutrition and deficiency are causing blindness and disability. Critics of Vitamin A rice point to the possible health effects of over-consumption (Shiva 2000a), the need for clinical trials to ascertain its medical effectiveness (Gepts 2002), but most of all maintain that direct access to a diverse diet of vegetables and legumes will always be more nutritious – and desirable – than rice engineered to contain essential proteins (Ho 1998; Cooley 2002).

Criticisms of the project to address hunger with biotechnology rest on two interrelated arguments. The first is a broader criticism of neoliberal globalisation within which biotechnological agriculture is seen to exacerbate the inequities inherent in the global market. These inequities are seen in the persistently disadvantageous terms of trade and the effects of dislocation and unemployment, but also the centralisation of economic power in unaccountable corporations and the extension of intellectual property rights (Smith 1999). The second argument is essentially a refutation of biotechnology’s claim to production efficiency that challenges the assumption of an either/or choice between conventional industrial and biotechnological models of agriculture and is tied to the question of whether genetic engineering has a place in an authentic sustainable agriculture. The first relates to the political economy of biotechnology, the second to the particular paradigm of food production that it relies upon.

The political economy of biotechnology

The technique of genetic engineering was born in public scientific laboratories and private universities with the experimental recombinant-DNA (r-DNA) projects of the early 1970s but its further funding, research and development has principally been undertaken in the service of commercial product manufacture. The commercialisation of genetic engineering has granted its ‘life science’ corporations significant and increasing power in pharmaceutical, medical and agricultural industries, which it also exerts over regulatory processes at the national level and international level. Control of global trade in agricultural

produce is exercised by a decreasing number of increasingly large corporations, and the corporate landscape of biotechnology is an oligopoly that is characterised by frequent acquisitions and relinquishments, mergers, alliances, and ventures. Corporations have integrated horizontally across a range of related industries, and vertically to incorporate all aspects of the food production and distribution chain – from ‘farm to fork’ (Tokar 1998; Kneen 1999; Pistorius & van Wijk 1999; Bowring 2002). The consolidation of global seed, agrichemical and biotechnological interests have given rise to the so-called ‘Gene Giants’ that dominate the global market for genetically engineered seeds – Syngenta, Monsanto, Bayer, DuPont and Dow (ETC Group 2005). The domination of global food production and trade by large corporations – with the top 10 seed corporations in the world accounting for 49 percent of the food seed market, and the top 10 publicly traded biotechnology corporations (included medical companies) accounting for 72 percent of the global market (ETC Group 2005) – is amplified by the incorporation of genetic engineering technology in agriculture:

Propelled by mergers, strategic alliances and joint ventures between leading firms, the pattern of development is pointing towards the emergence of clusters of multinationals co-operating in achieving complete command of the food chain, from patent protection of transgenic germplasm, through chemical-assisted growing, to the collection and distribution of harvests and their processing into food (Bowring 2002: 109).

Concerns about the structure and operations of the political economy of biotechnology align with the broader contemporary social movement against globalisation and the increasing and unaccountable political and economic power of transnational corporations (see Lappe & Bailey 1998). These concerns have three emphases. The first is that the corporate profit-driven agenda of developing (and aggressively marketing) biotechnology crops works against claims that they will be useful for consumers, poor farmers, or hungry people. The concentration of power in the agrifood industry works against social and economic justice for farmers, and the corporate context of seeking profits and expanding markets puts assurances that genetic engineering is both safe and necessary under suspicion (Tripp 2001). The second is concerned with the close relationships between biotechnology corporations, governments, and international trade bodies. Governments have tended to align their regulatory systems to the requirements of industry and taken on the conflicting roles of both promoting and regulating the technology. The third concern is particular to the ever-expanding horizon of global capitalism and its appropriation of products of nature and local labours, specifically as seen in the privatisation of ‘life’ through intellectual property regimes.

Mistrust of the corporate agenda affects the trustworthiness of public relations material as a source of public information (Frewer & Shepard 1995; Frewer *et al.* 1998; Frewer 1999; Frewer *et al.* 2003; Olofsson *et al.* 2006), but the drive for profit shapes the biotechnological developments themselves. The release of Round-Up Ready™ crops onto the market coincided with the expiration of Monsanto's patent on the broad-spectrum herbicide. Licensing agreements with biotechnology farmers that stipulate exclusive use of the herbicide are effectively an extension of the patent, and the necessity for the trait of herbicide resistance beyond this context is questionable. Biotechnology is marketed under the banner of sustainable agriculture, but the nature of the 'life sciences' corporation as a consolidation of chemical, pharmaceutical and seed interests means that working to reduce chemical inputs is a simple conflict of interests (Peters, CJ. 2000) that clearly resolves in favour of the corporation. The focus is set on pesticide resistance, not pest resistance (Meyer 2000). A political economy appraisal of biotechnology points to its subsumption to the capitalist economy and argues that genetic engineering technology needs to be brought back into the sphere of publicly-funded and administered research so that it can properly serve the needs and interests of society (Kloppenber 1988). In the global market, the hopes of "intelligent, independent, and environmentally sensitive advocates of GMOs [genetically modified organisms]" (Meyer 2006: 10) who point to the potential for reducing herbicide and pesticide use are unlikely to be met: "[s]o long as the ends of biotechnology are defined by those seeking to maximise [profits], whatever promise might be found in GMOs is unlikely to be realised" (Meyer 2006: 10). Private development of profitable crops in favour of those that would meet genuine need is not new to the case of biotechnology – the long process of commodifying domesticated plants gained its first inroad with the celebrated hybrid corn of the 1930s. Because saved hybrid seeds do not breed 'true', hybrid breeds successfully separated food seed from seed as the means of production, establishing a market dependence on seed proprietors that would not have eventuated if the equally promising open pollinated varieties were those that were agronomically improved (Kloppenber 1988). Genetic engineering is the contemporary pinnacle of this commodification process. The development of plants that produce only sterile seeds, called Genetic Use Restriction Technologies (GURT) and dubbed 'terminator technology', as a way to prevent seed saving and so protect intellectual property, is a case in point. The patent on plants with no progeny seed viability is now owned by Monsanto, following their purchase of the Delta and Pine Land Company, which recently retracted their initial public promise not to develop crops using the technology (ETC Group 2003). The direction of genetic engineering technology by the imperatives of the market also affects regulatory decisions and state determinations of risk that normalise and indeed 'fetishise' market forces; excepting the perceived irrationality of consumer decision-making (Levidow 2001).

The consolidation of economic power in food production corporations is argued to impinge on the rights of farmers, both those who grow biotechnology crops under restrictive contracts that demand very specific crop management practices (Abaidoo 2000) and those who do not. The much-publicised case of Percy Schmeiser – a Canadian canola farmer whose conventional crop became unintentionally mixed with Round-Up Ready canola that drifted from neighbouring farms and who was subsequently sued by Monsanto for breach of patent and retrospective royalty payments – is the landmark case for the likely effects of corporate biotechnology on farmers (Burrell & Hubicki 2005; Cullet 2005). Schmeiser argued in his defence that Monsanto's patent was invalid because the corporation had not taken responsibility for ensuring that the patented subject was spatially confined, but the courts found that Monsanto had indeed taken measures to protect their patent, specifically, the policing, detection and random crop testing measures that led to the civil action against Schmeiser in the first place. The presiding judge ruled:

[a] farmer whose field contains seeds or plants originating from seed spilled into them, or blown as seed, in swaths from a neighbour's land or even growing from germination by pollen carried into his field from elsewhere by insects, birds, or by the wind, may own the seed or plants on his land even if he did not set about to plant them. He does not, however, own the right to use the patented gene, or the seed or plant containing the patented gene or cell (in François 2003: 63-64).

The success of such legal actions relieves the onus of responsibility upon industry to ensure that the crops are ecologically safe before they are commercially released, or to ensure that they will not spread to contaminate the crops of other farmers – an even stronger concern for organic farmers. The political and economic power of corporations has allowed them to routinely avoid responsibility for the possible negative impacts of their genetically engineered products. Resistance to such 'corporate despoiling' is one aspect of broader anti-globalisation movements (Smith 1999), but is also bound up with moral concerns about naturalness *via* their dual categorisation as 'white environmentalism' (Pakulski & Tranter 2004), with both 'strains' of white environmentalism concerned with the 'moral-ethical' implications of biotechnology and other new technologies.

The public/expert split and the regulation of GE organisms

The free trade agenda that is advanced by international trade and governing bodies is also advocated by the biotechnology lobby (Smith 1999), which has been influential in the drafting and promoting of common permissive regulative standards and property rights agreements (Shiva 1997, 2001; Newell 2003; Newell 2008). This influence is nowhere more apparent than in the US, the world leader in production and use of GM crops, where the

regulatory system is based upon the concept of substantial equivalence²⁹ and genetically engineered organisms are assessed by existing government agencies rather than under new legislation³⁰. However, a pro-biotechnology stance is observable across governments. Genetic engineering appears as the exemplar case of progress where “the interests of industries coincide with governments’ own definitions of their national interests” (Newell 2003: 62), specifically, ensuring the global competitiveness of their primary industry. Governments have generally adopted permissive regulatory approaches (Hindmarsh & Gottweis 2005; McGiffen 2005), but the relative strength of Europe’s environment lobby and the extent of public protest activity (Rosendal 2005) has seen its divergence from this pattern and its qualified adoption of the precautionary principle (Gent 1999; Murphy *et al.* 2006).

The precautionary principle has many versions – weak and strong (Myhr & Traavik 2003), hard and soft (Bruce 2002a) – but essentially it mobilises precautionary action where the risks of a particular product or activity are plausible but are not scientifically certain (Jensen 2002; Conko 2003). The regulatory effect is to shift the burden of proof from opponents having to show that a product or activity is harmful, to promoters needing to demonstrate that it is safe (Matthee & Vermersch 2000; Van den Belt & Gremmen 2002). The US and the EU systems are often studied as the paradigm points of divergence, with the difference between substantial equivalence and precaution in practice being described as the European Union asking ‘why?’ while the United States asks ‘why not?’ (Young 2003). Critics of the precautionary principle argue that it represents a non-scientific hindrance to trade and technology development, and runs counter to the ‘sound science’ model adopted in the US (Murphy, Levidow & Carr 2006) and followed in Australia³¹ (Hindmarsh 2005). The EU adoption of the precautionary stance underpinned its *de facto* moratorium on genetically engineered crop imports from 1999-2004, which was the subject of an upheld US complaint of protectionism to the World Trade Organisation (WTO) (Abels 2005; Rosendal 2005). The impact of the EU moratorium and its stricter regulatory standards on US grain trade has constituted a transatlantic ‘trade war’ (Matthee & Vermersch 2000; Pollack & Shaffer 2000;

²⁹ The concept of substantial equivalence was developed by the Organisation for Economic Cooperation and Development (OECD), the World Health Organisation (WHO) and the Food and Agriculture Organisation (FAO) of the United Nations (UN) as a principle for the comparison of risks between GMOs and traditional plant breeding techniques.

³⁰ This ‘institutional hybridisation’ – also seen in countries that have legislated for genetically engineered organisms – reflects the inherent boundary transgression of genetic engineering (Brown & Michaels 2004).

³¹ Although Australia developed specific legislation to regulate genetically engineered organisms (*Gene Technology Act 2000* [Cth]) within which there is reference to the precautionary approach, this has not been implemented in practice (Hindmarsh 2005). It also retains a degree of ‘institutional hybridisation’ with the *Gene Technology Act 2000* (Cth), the *Australia New Zealand Food Authority (ANZFA) Act 1991* (Cth), the *Therapeutic Goods Administration (TGA) Act 1989* (Cth), the *Agricultural and Veterinary Chemicals Code Act 1994* (Cth), and other legislation related to importing and exporting requirements all playing a regulatory role.

Young 2003; Cooley 2004) that has demonstrated, *inter alia*, that there remains a fundamental irreconcilability between the precautionary principle and international free trade in genetically engineered crops (Matthee & Vermersch 2000).

The basic tenet of the precautionary principle is that activities that harm the environment ought to be restricted. It is embedded in various forms in international environmental agreements and is otherwise accepted as a basis for approaching risks in the case of scientific uncertainty, even though the detail of when it can and should be applied, and with what degree of precaution, is still unclear (Jensen 2002; Mayer & Stirling 2002; Myhr & Traavik 2002; Van Dommelen 2002; Myhr & Traavik 2003). Its adoption in the regulation of genetically engineered organisms shows that the process of genetic engineering in the EU is seen to be novel and inherently risky. Substantial equivalence, by definition, is not concerned with the process of genetic engineering but only with the measurable characteristics of its biological products (Myhr & Traavik 2003; McGiffen 2005). The divergence between the US and EU approaches – though not necessarily the clear cut case of precaution versus sound science that they are purported to be³² – lies in their view of whether the genetically engineered organism is significantly dissimilar from what has come before it. Their respective regulatory choices “position the novel ontologies created by biotechnology either on the side of the familiar and manageable or on the side of the unknown and insupportably risky” (Jasanoff 2005: 139). Public defenders of biotechnology “talk as if there were only one history of agriculture” (François 2003: 44), as if there was ‘a direct, unilateral course’ between the first seeds saved and the RoundUp Ready™ soy introduced in 1996. Yet maintaining their defence of substantial equivalence while promoting the technology as innovative entails a ‘delicate balancing act’, with industry marketing strategies representing the technology as ‘at once familiar and revolutionary’ (François 2003: 49). This tension is partially resolved in public relations appeals to the specificity of genetic engineering techniques over older forms of plant breeding (Krimsky 1997; François 2003), but the question of whether genetic engineering represents a revolution or is merely an evolution of morally and ecologically unproblematic practices goes to the heart of the debate³³, and the criticisms and counter-criticisms of regulation as a “political technology for the normalisation of biotechnology” (Hindmarsh 2005: 374).

³² Analysis of the regulatory and monitoring processes of *Bacillus thuringiensis* (Bt) maize in the US and the EU shows that the US is more precautionary and the EU more permissive (and both are less homogenous) than this regulatory dualism assumes (Murphy & Krimsky 2003; Murphy *et al.* 2006). The EU also has supra-national dimension that gives its workings additional complexity (Dunlop 2000).

³³ See Chapter Two for a detailed discussion on the rhetorical tensions of defending both revolutionary and evolutionary visions of biotechnology.

Unfavourable judgements of non-precautionary government regulation point to the inability of these processes to take proper account of the ecological impact that novel organisms might have: regulatory processes are considered inadequate because they do not sufficiently acknowledge that there is scientific uncertainty about genetically engineered organisms (Bruce 2002a; Myhr & Traavik 2003; Abels 2005; Hindmarsh & Gottweis 2005; Walls *et al.* 2005; Wickson 2007). The data that the regulator uses to make risk assessments are not independently generated but provided by the applicant (Murphy *et al.* 2006). Despite industry assurances, there is much uncertainty about the safety of genetically engineered foods and the likelihood of negative ecological and agroecological impacts from the environmental release of genetically modified organisms. The kind of impact studies required to assess long term ecological effects are difficult, expensive and time-consuming to undertake (Clark & Lehman 2001; Lawson 2002; Lawson & Hindmarsh 2006). But the other significant cause of scientific uncertainty is conflict within the scientific community itself as to the dangers of genetic engineering on human health and the environment. The debate is not a simplistic conflict between ‘sound science’ and emotions³⁴: there is scientific evidence to support arguments on both sides. A 2005 bibliography of the evidence that substantiates concerns about the potential harmful effects of GE crops lists over 200 peer-reviewed scientific articles³⁵ (Weaver & Morris 2005). The discrepancy between this evidence and that which shows the positive or neutral effects of genetically engineered organisms has not been framed as one of genuine scientific doubt requiring open discourse and continued research but as a result of ‘junk science’ (Baker 2004; Krimsky 2005).

The notion of ‘junk science’ has been criticised as a rhetorical twist that creates “a false dichotomy between ‘good science’ and ‘bad science’ to derail any attempts to use the weight of circumstantial evidence and precautionary approaches to regulate biotechnology” (Krimsky 2005: 318). The politics of labelling discordant evidence ‘junk science’ are embedded in a context of increasing industry-university collaboration (Bowring 2002; Myhr & Traavik 2002), the privatisation of research and development funding (Resnik 2000; Welsh & Glenna 2006) and the power of funding corporations to silence or discredit dissenting evidence (Scott 2003). Scientific evidence that supports a no-risk model of releasing genetically engineered organisms is suspected of being biased by the authoring scientists’ financial interests; industry sponsorship, profit considerations for increasingly market-dependent research universities and the acquisition of patent rights all equate to

³⁴ This perception was epitomised when Victoria announced its moratorium on GE crops and Monsanto responded that “[c]learly sound science doesn’t mean anything to the Bracks Government” (Baker 2004).

³⁵ They have been shown to result in increased insect resistance to pesticides, loss of biodiversity, and horizontal gene transfer, as well as demonstrating the toxicity of insecticide crops on non-target insects and soil organisms, and compositional differences between genetically engineered and conventionally-bred plants.

professional pressures for industry scientists to report favourable findings from their research. Given that knowledge of scientific evidence that strongly contradicts what is presented by biotechnology advocates tends to increase public disquiet and scepticism of industry and governmental assurances (Walls *et al.* 2005), the notion of ‘junk science’ is also mobilised to temper public mistrust. The two main scientific controversies over genetic engineering – the proposed ill-health effects on rats fed with GE potatoes, and the alleged spread of GE maize genes to local maize in a remote area of Mexico – were driven by mistrust of industry links and anti-biotechnology bias (Scott 2003). Industry control over scientific research is identified as subverting reasonable scientific discourse over genetic engineering and producing a conflict of scientific legitimacy.

The silencing of dissenting science and lay viewpoints is attributed to the governing of the regulatory process by ‘bioelites’

formed by a top tier of corporate industrialists (typically representing life science corporations as well as technology developers and financiers), scientists (typically representing the biosciences in both public and private research and development sectors), bureaucrats (typically those in state agencies of science, technology, commerce, trade, agriculture, health and industrial development), and science and technology advisors to business and government (typically a mix of the former three, as well as corporate lawyers) (Hindmarsh 2005: 376).

Governments are bound to the dual role of promoting *and* regulating biotechnology. Given that the ‘bioelites’ also tend to inhabit a revolving door between industry and government, this conflicting function compromises governments’ duties to represent the concerns and values of their citizens (Newell 2003).

Regulations are also seen as inadequate because they restrict public participation in determinations about this new controversial technology (Weiner 2001; Dietrich & Schibeci 2003; Hindmarsh & Gottweis 2005; Walls *et al.* 2005). They cast the public as consumers, rather than citizens, and limit opportunities for articulating public concerns about biotechnology to letters to the editor, submissions to parliament, and participation in public surveys. Survey tools typically seek agreement with, or refutation of, pre-composed statements. For example, in the 1999 Eurobarometer study, the statement that ‘even if GM food has advantages it is fundamentally unnatural’ (INRA 2000) was strongly agreed to by 45 percent and somewhat agreed to by 27 percent of participants; a 2000 Texan study sought responses to the statement that ‘GE food is fundamentally against nature’ (Streiffer & Hedemann 2005) and got a 75 percent agreement rate; and the statement that genetically engineered food was ‘unnatural’ received a 53 percent agreement rate from surveyed New Zealanders (Cook *et al.* 2004). The statistics these surveys generate provide a strong

indication of moral opinion but are limited in what they can say about the ethical basis of this opinion (Straughan 2000). Meanwhile, ethical questions about biotechnology are treated separately by specialist ethics committees that have a non-essential role in risk assessment processes.

Where proponents of biotechnology have advocated for public participation, it is primarily with the aim of engendering public trust and confidence in the system rather than to actually incorporate their concerns³⁶ (Jaffe 2004; Irwin 2006). The public/expert split of risk assessment processes excludes the public on the basis of their lack of specialised knowledge, but this naiveté can be a positive trait (Evernden 1985). In contrast to the trained objectivity of the scientist, the white environmentalists' concerns about naturalness are a protest on behalf of the value of nature, which comes from a lived and multi-sensory experience and provides a valuable perspective for evaluating the desirability of making significant changes to the stuff of that experience. Just as a less permissive risk assessment process would acknowledge dissenting scientific opinion and the existence of uncertainty about the extent of the measurable harm posed by biotechnological food and agriculture to human health and the environment (Hindmarsh 2008), a participative model of governance would be able to give this perspective more generous consideration. In such situations, where both scientific uncertainty and the extent of damage that could result is high, "lay people's arguments should be listened to on equal footing with expert opinion" (Myskja 2006: 232). Listening requires, in the first instance, careful appraisal of the substance of these arguments, and their translation from 'moral feeling' into a meaningful ethical framework (Kershen 2000; Straughan 2000; Devos *et al.* 2008). Even the simple goal of trying to resolve enduring conflicts in the debate provides, on its own, a "strong practical argument in favour of examining the ethical basis of such concerns" (Straughan 2000: 163).

Intellectual property rights over living organisms

The protest on behalf of the value of nature also plays out in criticisms of patents on living organisms and the rejection of the ownership of living things because of their naturalness and aliveness. This perspective speaks to the ontological question of what kind of entity the genetically engineered organism is, which is revisited from a philosophical standpoint in later chapters. At the level of the public debates, conflict over the expansion of intellectual property rights to include genetic material, micro-organisms and other higher forms of life

³⁶ The marginalisation of non-scientific concerns in the regulatory process is a common property of regulatory systems. State regulation of genetic engineering has been framed as a properly scientific exercise since the 1970s, when concerns over early genetic experiments on micro-organisms were resolved with assurances of laboratory containment and the establishment of self-regulatory mechanisms in the watershed 'Asilomar' conference of 1975 (see Appendix One: *Asilomar*).

rests on the dual assertions that owning forms of life, as distinct from merely owning individual life forms (Meyer 2000), is wrong in-principle, and that granting such property rights will have unwanted social, economic, political and agricultural consequences. Thus, “[c]entral to the patenting of life (from cell lines to organisms) are issues of exploitation, economic justice, and the ethics of ownership; so is the vision of nature as a self-standing source of value and authority that ought to remain absolutely distinct from human intervention” (Daston & Vidal 2004: 13). Like other sites of controversy over biotechnology, the broader political and economic issues are complex and significant, and tend to overshadow moral objections.

However, the popular intuition that it is immoral to own life³⁷ or to cast it as a human invention is supported by academic refutations of the patentability of living organisms for failing the criteria of non-obviousness and prior art, and subverting the intended goal of patent protection. Consequentialist objections to patents – and plant breeders, or plant variety, rights – are concerned with the effects that they have on the free exchange of plant genetic material, both within the scientific community and between farmers, the consolidation of seed industry interests, and the monopolistic control they grant to already powerful corporations to remove the fundamentals of life from the public sphere. Proponents of plant intellectual property appeal to the role of patent protection as an incentive for private innovation by arguing that patents are necessary economic instruments for recouping the extensive research and development funding required within the biotechnology industry (for example, Doll 1998).

Patenting forms of life as human inventions was launched in the landmark decision by the US Supreme Court in 1980 (*Diamond v. Chakravarty*) to allow a patent to be granted for a micro-organism that had been genetically altered to process waste oil more effectively. This slim majority (5-4) judgment established that being alive did not preclude something from being an invention: “the relevant distinction is not between living and inanimate things, but between products of nature, whether living or not, and human-made inventions” (*Diamond v. Chakravarty* in Meyer 2006: 7). US-style patenting regimes have been internationalised through the World Trade Organisation’s (WTO) Trade-Related Aspects of Intellectual Property Rights agreement (TRIPs) that obligates WTO members to implement suitable plant intellectual property regimes³⁸ (Alexandra 2001; Borowiak 2004). Australia’s Patents

³⁷ One of the legal arguments made in Greenpeace’s unsuccessful challenge of an EU patent for a herbicide resistant plant (Forsyth 2000).

³⁸ Though Canada’s patent legislation does not allow the patenting of higher life forms like plants and animals, Monsanto’s proprietary rights over RoundUp Ready canola was upheld in the Canadian Schmeiser case because the crop plant contains the patented genes within it.

Act of 1990 goes even further to protect biotech industry interests than Australia is internationally obliged to as a signatory to TRIPs by omitting any guidelines about the patenting of life beyond the exclusion of human beings and the biological processes for their reproduction. The Australian Patents Office has instead followed the lead of the US Patent Office and the Supreme Court decision in drawing no distinction between living and non-living subject matter when granting patent protection (Forsyth 2000; Taliadoros & Muratore 2000). This protection offers a temporally limited monopoly – 20 years in Australia – on the exclusive right to sell, exploit, make, hire, use and import the patented product, to license others to do the same and to charge royalties on the sales of seeds and other propagating material (*The Patents Act 1990* [Cth]). Plant breeders' rights – legislated for in Australia in 1987, and again in 1994³⁹ – provide propriety protection to produce, sell and reproduce any plant variety that is not commonly known, including newly discovered and genetically engineered types. The criteria for intellectual property protection are only that the plant be *distinct* from known varieties, *uniform* within each generation and *stable* through generations⁴⁰. The criteria for patentable plants are that they need to be useful, novel, involve an inventive step and able to be disclosed in a way that can be understood by others (*The Patents Act 1990* [Cth]). The key difference between plant breeders' rights and patent rights is that under the former farmers can still retain seeds for replanting, sell seeds from their crop to their neighbours for replanting and commercially for food. Plant breeders' rights apply quite straightforwardly to plant varieties; there is no standard of inventiveness, nor does the variety need to be described, nor does it have to be useful (Alexandra 2001). Both plant breeders' rights and patents have been criticised for providing corporate interests with the means to privatise a public good without providing a corresponding public gain (Garcia 2002; Nelkin 2002). Yet biotechnology patents, regularly granted for “genetically engineered bacteria, plants and non-human organisms, synthetic genes or DNA sequences, mutant forms and fragments of gene sequences, the DNA coding sequence for a gene, the protein expressed by the gene, host cells carrying the gene, higher plants/animals carrying the gene, and perhaps most significantly – DNA and genes” (Hindmarsh 1998), provide their holders with unprecedented exclusionary rights over food seed and are the primary focus of condemnation.

The logic of granting intellectual property rights on human inventions – other than to serve as an economic incentive for innovation – is Lockean in character (Alexandra & Walsh

³⁹ The *Plant Breeders' Rights Act 1994* (Cth) replaced the *Plant Variety Rights Act 1987* (Cth) and was a controversial Act that increased the privatisation of the seed industry and saw a decrease in the availability of open pollinated varieties (Hindmarsh 1999).

⁴⁰ Characteristics that are useful for ascertaining ownership, though not necessarily for sustainable agronomic purposes given the need for crops to coevolve with their pests and diseases (Busch 1995a; Mooney 1990).

1997; Meyer 2000; Plumwood 2002; Meyer 2006). In Locke's labour theory of property, private property is created when human labour is mixed with nature; the cultivation of a field or the building of a house makes those things or places the property of the labourer. The nature that is amalgamated with human labour is otherwise unowned and uncultivated – a veritable wilderness. This assumption of an existent 'pure' nature can only be upheld if the previous contributions of other human activities in the shaping of that nature are overlooked, except in those rare cases of authentic remote wilderness. The domesticated plants that are the subject of biotechnological interventions are certainly not 'nature' in the wilderness sense, but have been produced through the mixing of labour and food plants over countless generations:

Just as Locke's view of America as a state of nature prevented him from acknowledging the labor of its native inhabitants, so does the conclusion that genetically engineered species are distinctively products of human art—inventions—obscure the vital role of everyone from third world farmers to Mendelian plant breeders in the development and maintenance of the current diversity of genetic material on the planet (Meyer 2000: 171).

The vital role of current and predecessor labours in the creation of agrobiodiversity is necessarily ignored when granting inventor's rights: if 'invention' is what takes place in the laboratory then those plant breeding activities undertaken outside the highly technical scope of biotechnology projects must be naturalised as a free good (Shiva 2000b; Warner 2001). The debate about patents over biotechnologically modified plants is essentially a political struggle to make these contributions visible. Although the Convention on Biological Diversity (UNEP 1992) recognises the countries of origin of the plant germplasm, Third world farmer networks in coalition with NGOs are campaigning for a comprehensive system of farmers' rights that are on par with current intellectual property regimes (Shiva 1995; Fowler 2000, 2001; Shiva 2001; Borowiak 2004). Farmer labour has not only created genetic diversity but specific knowledge of the uses of its characteristics. Patenting minor modifications, isolated gene sequences, or the insertion of these sequences into other plants as new 'inventions' amounts to 'biopiracy', and contravenes patent law by not recognising 'prior art'. This argument was the basis of a successful challenge made by the EU Parliament's Green Party, Dr. Vandana Shiva and the International Federation of Organic Agriculture Movement (IFOAM), of the EU patent granted for a fungicide made from the oil of the Indian neem tree; simply, its fungicidal properties were well-known and it has been used for that purpose for centuries (IFOAM 2005; Hamilton 2006). The use of neem oil in a commercial application was subsequently upheld as 'obvious' and lacking the inventive step necessary for patent protection.

Critics query how genes and gene sequences can be regarded as ‘inventions’ when at best they should appear as discoveries, not unlike the elements of the periodic table that did not grant its authors property rights over Helium or Hydrogen (Rifkin 1999). The inventiveness of gene sequences lies in their novelty – isolating the genes from their natural environment and identifying them through strings of data is considered to have made them available to the public (in this form) for the first time. The requirement of novelty is “not whether the invention has existed previously, but whether or not it was publicly available at the priority date of the application of the patent” (Taliadoros & Muratore 2000: 119). That these genes in their embodied form are the basis of natural living organisms is not relevant; they have not before existed in the isolated and purified form into which the biotechnology laboratory transforms them. The question does remain however, as to whether the high-throughput technical procedural process of ‘discovery’ of useful genes through the laboratory meets the criteria of inventiveness, as it has now become so routine as to be obvious to a skilled worker in the field (Busch 1995a; Taliadoros & Muratore 2000).

Even within industry there is conflict over the value of patents. It is argued that they can hinder innovation and development, as monopoly rights over processes and products make it harder for others in the field to conduct research without encountering impeding requests for royalties (Mooney 1980; Lawson 1998; Forsyth 2000; Nelkin 2002). The standard argument for patents as an incentive for undertaking long periods of research without return is seriously weakened by attention to the amount of direct government funding given over to public and private research (Alexandra 2001). Monopoly property rights are granted to private corporations on top of money already given over from public grants, while the structure of biotechnology innovation relies heavily on public funds in another way – through the use of university facilities, staff and research (Kenney 1986; Bowring 2002; Welsh & Glenna 2006). Often university research is undertaken in ‘collaboration’ with private enterprise, while in other cases large private companies take over once research has reached the stage where a commercially useful product or process can be identified, bringing the innovation to market, and applying for patent protection to do so (Zilberman *et al.* 1999). Biotechnology receives public funding support twice – in the research phase *and* in the sale of its products under patent protection. It is also argued that patent protection is better suited to mature industries where the innovation is regular and stable (Gold 2000), and the biotechnology industry is characterised by vehement competition and intense patenting activity. It is an industry in its formative stage, reliant on a fast pace of innovation. Even though it is not in an economic position to serve society’s interests through patent protection, its financial dependence on patent protection exploits the law that is designed to ensure the public good. There is no strong evidence to uphold the argument that patent

protection is economically beneficial (Lawson 1998) – particularly in light of the costs of policing (Alexandra & Walsh 1997) – even without engaging with the macro-economic question of whether financial gains accruing to industry do anything positive in terms of contributing to the public good.

Patents are a legal mechanism of excludability, while seed hybridisation and the potential ‘terminator’ varieties are a technical mechanism. Both separate food seed as an object of consumption from sowing seed as a commodified means of production. The erosion of the rights of farmer communities over seed and cultural heritage by way of ‘biopiracy’ and legal restrictions on seed saving and farmer-to-farmer exchange is not a matter of outdated agrarianism giving way to right and necessary progress; intellectual property is “inherently political”, not about innovation, economics or protection, but “the expansion and production of power” (Bowring 2002: 117). There exists, then, a fundamental conflict in values between those who consider the domesticated natural world as our shared heritage⁴¹ and those who view agrobiological diversity as a site for the expansion of private property (Onwuekwe 2004).

Material nature: environmental concerns

Concerns about genetic engineering that can be broadly described as ‘environmental’ are concerned with material nature and the risk of measurable environmental harm but still enact a discourse about the quality and desirability of naturalness in agriculture. Environmental concerns relate to a set of competing claims about whether biotechnologically modified crops are able to realise the goal of sustainable agriculture (Kloppenburger & Burrows 1996; Hubbell & Welsh 1998; Mannion 1998; Singh 2000; Paoletti & Pimentel 2001). Biotechnology proponents argue that genetically engineered crops will reduce the amount of chemical contaminants released into the surrounding environment, retain vital agronomic elements and protect wild biodiversity. Others claim that biotechnology is not able to realise these goals in practice or, that as an extension of the industro-chemical mode of production that has characterised modern agriculture as polluting, soil eroding and heavily input-dependent, it has no place in a sustainable agriculture framework. There are two elements to the sustainability conflict. The first is the agronomic question of whether agricultural systems that incorporate biotechnology crops will be more sustainable than current industrial modes of production or, indeed, whether

⁴¹ The ‘common heritage’ view is espoused by biotechnology corporations while they prospect for plant germplasm, but abandoned once they gain proprietary rights through the laboratory transformation of heritage into an invention (Warner 2001).

other modes of production are more viable. The second is the environmental question of whether genetically engineered crops have characteristics that make them more likely to contaminate wild and domesticated nature. The resolution of both is dependent on the role of the quality of naturalness in definitions of sustainability.

Claims made in favour of biotechnology in agriculture maintain that the characteristics of herbicide resistance and pesticide expression are a sustainable solution to the problem of agricultural chemical use. Plants that are engineered to express insecticides in their cells will reduce the need to apply soluble chemicals, decreasing their flow-on effects to wild nature via direct exposure, water ways, and other ecological pathways. Pesticides kill beneficial predator insects, accumulate in the food chain and drift into surrounding areas, but pest resistant plants – specifically those engineered to express *Bacillus thuringiensis* (*Bt*), a naturally occurring bacteria that manufactures insecticidal proteins, and has long been used as biological control in organic farming – are targeted at those insects that feed on the crop (see Salleh 2001). The insecticide-producing genes of *Bt* have been isolated, modified and inserted into major food crops like potatoes and corn⁴². Herbicide resistant plants will promote a reduction in the use of herbicides through carefully timed application programs. This eliminates the need for farmers to plough or apply herbicides before planting and supports minimum tillage systems that prevent soil erosion (Crouch 2001; Schutte 2003). Based on the estimated losses of yield to uncontrolled pests and weeds, both kinds of crop modifications will lead to increased yields. On this basis, it is argued that these crops will prevent further destruction of existing wilderness areas for farmland. Such agricultural intensification through biotechnology that ‘does more with less’ (Kern 2002) is considered necessary if humanity is to respond to the world hunger crisis and survive climate change without compromising biodiversity, overusing natural resources like land and water, or losing the ecological services that are provided by areas of wild nature (Mannion 1998). Thus biotechnological agriculture is portrayed as ‘agriculture in harmony with nature’ (Agriculture & Agri-Food Canada 1997), and the only viable system to meet the needs of the poor while adhering to ecological limits. As “a world of 6 billion people simply does not have the option of abandoning modern agriculture entirely and embracing a romanticised peasant past” (Pilcher 2006: 106-107), it is to the genetic engineering of agricultural seeds for particular characteristics that the answers to soil erosion, rainforest preservation and world hunger are sought. However, the benefits claimed for genetically engineered crops are not without attendant risks, both for the surrounding environment and within the agricultural field.

Agronomic risks

Opponents of biotechnology on sustainability grounds argue that the use of genetically engineered crops in agriculture will only exacerbate the existing detrimental environmental effects of industrial agriculture. It will encourage a genetic-chemical treadmill that will mirror industrial agriculture's dependence on chemicals. It will misuse biological resources. It will have unique and irrevocable environmental impacts that will also affect the livelihoods of organic and conventional farmers. Even where there may be a place for biotechnologically produced crops in sustainable agriculture, this is not being reflected in the kinds of traits that are currently being engineered, namely pest and herbicide resistance. Other kinds of genetic modifications – such as the creation of low cost, environmentally benign crops that can withstand environmental stress, grow perennially not annually and make more efficient use of natural fertilisers – would be a more appropriate step in the direction of sustainable agriculture (Hubbell & Welsh 1998; Hilder & Boulter 1999; Paoletti & Pimentel 2000). In the main, though, it is the selection of a 'technological fix' as the research and development priority in agriculture in lieu of organic and ecological approaches that is the main issue of concern (Thompson 1997c, 2003b, 2006), and has been since early talk of introducing genetic engineering into agriculture (Levidow 2001). Biotechnology represents the same narrow technological approach to fixing agricultural problems that is responsible for the cause of agricultural pollution and unsustainability (Scott 2005) by disregarding ecological principles of production in favour of developing technological means to transcend natural limits. Critics reject genetic engineering as an ideal of sustainable agriculture and point to the single rotation monocultural conditions as the basis of most pest problems. They advocate other models of sustainability, such as integrated pest management strategies, polycultural modes of production, crop plant diversity, perennial plantings to protect against soil erosion and to attract and support beneficial insects, rotational sowing with nitrogen fixing legumes, and land-use strategies that maintain conservation and boundary regions (Mies & Bennholdt-Thomsen 1999; Shiva 2000b; Schutte 2003; Cox *et al.* 2004; Tybirk *et al.* 2004). Under these definitions, sustainable agriculture will only be possible when research dollars are directed into organic production instead of the further industrialisation of agriculture.

The projected agronomic effects of genetically engineered crops support this argument. Herbicide resistant crops necessarily encourage the perpetual use of herbicides, while pest resistant crops will quickly become redundant and require the development of further genetic or chemical fixes. The risk of target insects developing a resistance to *Bt* through

⁴² Also non-food crops such as cotton, which comprised 9.8 million hectares or 11% of all biotech crops grown in 2005 (James 2005).

constant exposure to large scale *Bt* crops is near-certain, and is recognised by critics and industry and regulators alike. The mainstream management plan to offset this problem is to set aside ‘refuges’, areas planted out to a conventional variety where non-resistant insects can thrive. The competing priorities of short term profitable production and medium term migration of resistance has led to the designation of too small refuges to be effective (Scott 2005). In a ‘dust’ form, *Bt* has traditionally been used as a biological control by organic farmers. Once resistance to the bacterium is widespread, the unique *Bt* reserve will have been ‘used up’, making this useful shared resource useless for biotechnology and organic farmers alike. It has also not lived up to producers’ expectations; of note is the failure of Texan-planted *Bt* cotton to control the borer that led to legal action by a farmer coalition (Hilder & Boulter 1999; Schutte 2003).

A key criticism of agricultural biotechnology is that wind-borne genetic engineered seeds will spread to surrounding farms. The economic risk is that organic farmers could lose their organic certification, and both organic and conventional farmers could face legal action by the crop patent holder for royalty payments (OFA 2001; Burrell & Hubicki 2005). The attendant risk is that genetically engineered crops will eventually spread so far as to become ubiquitous in the food chain. There will be no need for segregation and labelling, and no place for other agricultural models; in short, no alternative.

Risks to wild nature

Risks to wild nature are those that the genetically engineered organism, broadly speaking, poses to its surrounding ecology. The first ecological risk is borne by those wild organisms that cohabitate in the agricultural field. When *Bt* is used as a bacterial ‘dust’, it is only activated in the specific gut environment of target insects – “[t]he working mechanism is based on specific receptor binding in susceptible insect larvae in epithelial cells of the midgut, leading to pore formation, cell lysis, disintegration of the epithelial lining in their midgut, and eventually to death of the larvae due to starvation” (Kuiper *et al.* 2001: 510-511) – but when it is expressed in plant tissue, the *Bt* toxin is active for all that consume it. There is evidence that it affects non-target and beneficial insects through the food chain. *Bt* toxins are also shown to persist in the soil and be taken up by soil microfauna (Weaver & Morris 2005). In the case of herbicide resistant crops, the heavy herbicide applications that are used in conjunction with those varieties removes the weed vegetation from the field that harbours beneficial insects and bird species. The second ecological risk of biotechnology crops relates to their impact on surrounding wild areas that are equivalent to those posed by industrial agriculture, for instance the glyphosate herbicides that are necessarily used in

conjunction with herbicide resistant crops are not benign but pose significant environmental hazards (Crouch 2001).

The third risk to wild nature is particular to genetic engineering as a technology and is that of gene introgression – the ‘escape’ of genes from genetically engineered plants into wild plant populations by the hybridisation of one species with another – and the subsequent establishment of the hybrid plant in the ecology (Hails 2000). The important questions in determining this risk are whether genetically engineered plants are more or less likely to introgress into wild populations⁴³ than conventional crops and whether this introgression would have more or less impact (Hails 2000; Gepts & Papa 2003). The environmental risk of genetic escape and the rates of invasiveness of these new hybrids are very hard to model (Clark & Lehman 2001). Biotechnology advocates maintain that the risk of introgression from genetically engineered crops is no more than that from domesticated crops generally (Beringer 2000). However, it is argued that the particular characteristics of genetically engineered organisms make gene transfer more likely (Gepts & Papa 2003). These characteristics relate to one of the key differences between domesticated and wild plants. Domesticated plants are typically unable to survive without the human interventions of irrigation, fertilisation and weeding, for more than a few generations. Their domestication into agricultural fields involved numerous changes to their genetic structure that can be summarised as representing the loss of ecological function, in particular the ability for cereal crops to shatter and disperse seeds. The kinds of changes that are being generated under genetic engineering, however, are different: they involve the gain of, rather than loss of, function (Gepts 2002).

Major biotechnology crops possess genetic resistance to specific herbicides and/or express active insecticides in their leaves and stems. The problems posed by gene flow include the transfer of herbicide resistance into crop relatives and the subsequent creation of ‘super weeds’ that will prove very difficult to eradicate chemically⁴⁴. Similarly, insect resistance might convey an ecological advantage to crop plants that leads to proliferation of weedy hybrids that are also injurious to insects. If genetically engineered gains of function are ecologically successful they may spread their genotypes to their wild indigenous relatives in those locations where they are part of wild nature. The success of the genetically engineered genotype would spell the decline of the wild genotypes, leading to a loss of diversity with

⁴³ And, of course, other domesticated populations in organic and conventional fields.

⁴⁴ In experimental conditions, it took two generations for the genetically engineered herbicide tolerant canola to transfer its transgene to a weedy relative (Myhr & Traavik 2003). It is worth noting though, that the already existing ecological problem of persistent weeds that have displayed a clear ecological advantage are a result of exotic horticulture but these actual weeds have not been nearly as controversial as the mere idea of genetically engineered weeds (Scott 2000).

implications for both wild nature (Ellstrand *et al.* 1999) and nature that is resourced for domesticated plant breeding (Gepts & Papa 2003). Of the 13 most important agricultural crop plants in the world, 12 are known to hybridise with wild relatives (Ellstrand *et al.* 1999; Rieseberg *et al.* 2003).

Risk of environmental damage depends, like other risks, on the likelihood of damage occurring and the extent of damage that would result. Full measure of the agronomic and ecological risks of farming genetically engineered crops is difficult to definitively determine because there remains a reasonable amount of scientific uncertainty about their impacts. This uncertainty stems from both the conflicting results of existing scientific studies of measurable harm and from the inadequate number of long term studies completed (Bruce 2002a; Myhr & Traavik 2003; Wickson 2007). Nonetheless, the risk of contamination and the range of mobility of introgressing organisms is made more likely by the time frames involved in the release of biotechnological organisms. Barbara Adam (1998, 1999, 2000) argues that attention needs to be given to the ‘timescapes’ of new technologies; when they are to be introduced, in what sequence, with what speed and intensity, and for how long: “[w]hen the answer has to be ‘for ever’, it dramatically changes the gravity of the issues involved” (Adam 2000: 133). Similarly, Kate Soper (2005: 133) notes that “[t]o commit to GM ... is to know that the pre-GM moment will not come again.” As living, relatively mobile, ecologically integrated organisms, genetically engineered crops cannot be cleaned up as an oil spill or recalled as some faulty good; their environmental release is irretrievable.

Naturalness and environmental concerns

The rejection of genetic engineering – in particular, its first generation products – as a component of sustainable agriculture is popularly articulated *via* an associative link between genetic engineering and unnaturalness. There exists qualitative differences between different modes of agricultural production, such that some can and do lay claim to being more natural than others⁴⁵. The strongest claim to naturalness is made by organic agriculture⁴⁶, not only in

⁴⁵ Two different approaches to agriculture and land use are also seen in the relative acceptance of biotechnology in agriculture in the US over Europe. Beyond differences in governance structures, and indeed attitudes to government that see a support for less rather than more regulation in the US, the respective place of agriculture is also distinctive (Herrick 2005; Sagoff 2002). In the US there is a strict land use split between farmland and wilderness areas, and rural areas are geographically remote from urban areas. US citizens have a higher risk threshold for biotechnological interventions in agriculture in part because domesticated nature is more noticeably separated from nature proper. In Europe, particularly Britain, wild nature is not a wilderness but a countryside that includes farmed rural land and is very accessible by car and on foot. The two jurisdictions have different experiences and expectations of nature and accordingly a different moral ranking of domesticated nature (Toke 2004).

⁴⁶ This claim to naturalness is also made on organic agriculture’s behalf through media representations of organic agriculture as a generic, natural solution to the problems of conventional modes of production (Lockie *et al.* 2002, Lockie *et al.* 2004).

its rejection of the use of all chemical pesticides and fertilisers and its maintenance of productive yields without these inputs, but in its integration of the agricultural field with the surrounding environment through agroecological principles and a commitment to an attitude of respect for the integrity of nature as a whole (Jackson 1991; Verhoog *et al.* 2003; Tybirk *et al.* 2004; Lammerts van Bueren & Struik 2005). For agricultural ethicist Paul Thompson (2003b), naturalness in agriculture is less about the exclusion of unnatural or inclusion of definitively natural elements and more to do with the approach taken by farmers to the nature they work with in the production of food crops. ‘Natural’ farmers are artisans who pay “attention to the natural properties of their materials” (2003: 38), and unnaturalness in farming is akin to a wood carver working ‘against the grain’. Farming modes that work ‘with the grain’ incorporate appropriate knowledge of the capacity and needs of agricultural plants and pay attention to site- and crop- specific natural variation. Naturalness then, presupposes a mindful relationship between land, farmer and plant in the production of an ecologically more resilient agricultural system. Other attempts to qualify naturalness in farming are more specific in identifying certain land and vegetation characteristics as displaying ‘nature quality’ (Tybirk *et al.* 2004). In this analysis, the most important criteria for nature quality is the functional integrity of the agro-ecosystems where “production should emulate and benefit from nature’s systems and cycles, and help sustain them” (Tybirk *et al.* 2004: 254). Agricultural systems that seek to imitate natural processes within the agricultural field are ‘natural’ in this regard, whereas biotechnology agriculture, which pursues a containment model of sustainability, remains embedded in an industrial framework of conventional agriculture that more closely approximates factory production than an ecological system. Sustainability in the biotechnology era “is no longer primarily a question of maintaining, and enhancing, existing environmental resources. It is also, increasingly, about engineering new environments” (Redclift 2001: 296).

These different ideals of sustainable agriculture work with different ideas not only of what is natural but also of what counts as nature. The sustainability model of biotechnology is primarily one of containment, in which ‘nature’ is what lies outside the confines of the agricultural field. Biotechnology is able to be framed as sustainable because it offers a way to mitigate the impacts of agricultural pollutants. It recognises the value of nature only to the extent that it espouses the protection of geographical areas of wild nature from the ecologically detrimental effects of contemporary agriculture. This is an agreed priority for both proponents and opponents of the technology, but in other models of sustainability that overtly identify with the quality of naturalness there is simply more that counts as nature than just the surrounding ecology. This nature includes, *inter alia*, the domesticated plants

that comprise the agricultural field itself. Accordingly, containment is only one aspect of the design of these systems.

Counting domesticated nature as nature is a baseline feature of the discourse of unnaturalness that runs through the many controversies about genetic engineering, not just environmental debates. The legitimacy of patents is questioned on the basis of the morality and feasibility of owning (domesticated) nature, while consumer preference for naturalness in food presupposes the pre-existing naturalness of (domesticated) food plants. White environmentalist critiques of biotechnology are delineated by their concern with what genetic engineering represents to the idea of nature, rather than to the materiality of nature through measurable harm. Yet such harm is a precondition for concern, for example, about the impact that the spread of transgenes in the wild might have on the perceived naturalness of that wilderness. The moral dimension of environmental harm is an inherent, though infrequently recognised, element of all environmental problems (Carolan 2008). In part, the categorisation of white environmentalism as primarily philosophical in orientation reflects the difficulty of translating concerns about the alteration of domesticated nature at the genetic level into a practical critique, given the tremendous amount of change that this nature has already undergone over domesticatory history. Like other environmentalisms, white environmentalism entails a protest against the viewing of nature – wild and domesticated – as merely a resource for human use (Evernden 1992). It reflects environmental sensibilities more generally: those who propound an environmentalist worldview⁴⁷ are more likely to oppose biotechnology in agriculture on philosophical grounds (Knight 2007). This kind of opposition is not altogether novel, but reproduces the standard conflict between environmentalists and industrialists, who simply possess “differing ideas about the proper order of things” (Evernden 1992: 6). Just as broader environmental debates are “not simply about the physical contamination of nature but about the moral contamination of an ideal” (Evernden 1992: 6), “debates over GMOs do not only concern ontological matters, which is to say that they cannot be framed (and understood) in purely materialist terms” (Carolan 2008: 70): the white environmentalist position on biotechnology is a fusion of political, environmental and moral objections. Its more significant point of departure from traditional environmentalisms lies in its extension of concerns about nature to concerns about the naturalness of the domesticated nature that comprises the agricultural field.

⁴⁷ The most common environmental worldview in the literature is the ecological paradigm (NEP) is a worldview which emphasises human dependency on nature, influence of nature, in which they are but one of many species, and are subject to the limits of the environment (For discussion on environmental worldviews see Knight [2007]).

Conclusion

This chapter has provided a review of the substance of a series of controversies about genetic engineering in agriculture, with particular attention to the roles and importance of ideas and ideals of nature across a range of debates. Naturalness is a pivotal issue in the consumer unwillingness to buy biotechnologically produced food, and questions about the status of nature as a free good and a cultural legacy are foremost in discussions about the extension of property rights to living organisms. Environmental questions about whether biotechnology can meet the goals of sustainable agriculture, whether it will have destructive impacts on the surrounding ecology, and whether it represents some kind of affront to nature on a conceptual level, are directly concerned with the implications of biotechnology for wild and domesticated nature.

The importance of disputes about ideas of nature to the wider debate is eclipsed by the gravity of what is at stake, socially, politically and economically. The robustness of state regulation of genetic engineering, the most effective pathways to the resolution of world hunger, and the structural inequities of the political economy of biotechnology are complex and significant issues. While the public *qua* consumers are strongly motivated by questions of naturalness, professionals have tended to rest their critique on evidence of scientifically measurable harm and social and economic injustice rather than the moral implications of biotechnology for nature. Concerns about nature “are not the issues about which all the commotion exists. They are not the issues about which farmers in the field, scientists at their bench, and academics in their study are commonly exercised” (Kline 1991: 216). They are, however, highly significant issues for public resistance to the technology, which has, in turn, played a considerable role in slowing biotechnological progress through the marketplace. They are key elements in conceptualisations of risks that underlie civic scepticism about the benefits of genetic engineering. That is, intrinsic objections to biotechnological interventions in nature have political import.

However, these concerns are rebuffed either by the trivialisation of the idea of naturalness in the context of agriculture or by recourse to technical arguments, such as the accuracy of the gene splicing method. This kind of rebuttal misconstrues the nature of these concerns, and of the debate more generally. The debate concerned with disputed facts, but is also a debate about ‘values and attitudes’ ‘involving philosophical ideas, ideology and politics’, ‘alternative visions of reality’, and even a ‘quarrel about dogmas’; in essence, “a debate that involves questions beyond which science is capable of answering” (Wickson 2004: 5; see also Carolan 2008). When genetic engineering is presented and evaluated as a technical choice, the only valid basis for its rejection is that it cannot deliver what it promises. Yet,

from the white environmental perspective, the successful delivery of what biotechnology promises – that is, the redesign of nature to human specifications – is the problem.

The conception of risk represented in risk regulation processes is restricted to the narrow scope of scientifically measurable harm. Public conceptions of risk are broader than just these harms and include risks such as the potential loss of livelihoods for conventional and organic farmers, the loss of non-GM markets overseas in the event of widescale adoption of GM crops, and the effect that the creation of biotechnological nature will have on the idea of nature and naturalness. These kinds of risk are not captured in the strictly technical understanding of risk of formal assessment processes, which has the effect of naturalising the mechanisms of the market. Accordingly, the extent of public contribution to the assessment of new biotechnological food and agriculture is limited to the role of the public as consumers exercising choice in the marketplace. In turn, the effectiveness of this role is dependent on the rigour of food labelling and segregation, which has, in many jurisdictions, been diluted by the efforts of ‘bioelites’ and the dual role of governments both regulating and promoting biotechnology as signatories to a range of international agricultural and intellectual property rights agreements. Popular concerns about nature and biotechnology are marginalised by the legislative and ambient political landscape.

Although concepts of nature and naturalness are only one aspect of what is at stake in genetic engineering controversies of far-reaching social and economic consequences, there is a political case for examining the basis of concerns about the implications of biotechnology for nature. The following chapter moves into an examination of the substance of these concerns, to determine the conceptual scope and ethical significance of moral objections to biotechnology.

Chapter Two

Biotechnology reframes nature: discourses of naturalness and domestication

Introduction

Philosophical concerns about the implications of genetic engineering for nature have played a key role in slowing the spread of agricultural biotechnology, specifically through the translation of these concerns into an unwillingness to consume genetically engineered food. There is genuine unease from proponents that the benefits of biotechnology will be foregone if effective resistance continues. At the same time, philosophical concerns are openly trivialised by biotechnology proponents, and deliberately avoided by opponents for whom the social and economic imperative to halt biotechnological progress demands that their critique be built on more solid ground. The political economy and regulatory environment of genetic engineering largely excludes non-technical, non-expert, and non-market perspectives in assessments of biotechnological risk. As such, attention to, and elucidation of, claims of unnaturalness – which are typically framed as a series of emotional, in contrast to rational, concerns – has been significantly limited by the ambient political landscape and governance mechanisms of the biotechnology debate.

This chapter will examine three ancillary factors that have moderated scholarly examination of philosophical concerns about nature and that need to be taken into consideration in the development of any instructive analysis of their ethical basis. These relate to the entanglement of issues of philosophical substance with the modes of rhetoric employed throughout the debate. First, concerns about the morality of the biotechnological relationship with nature are subject to the same limitations of any argument that makes recourse to nature for moral authority. These limitations are only amplified by the tendency to articulate these concerns in truncated, dualistic terms, specifically through the identification of genetic engineering as ‘unnatural’. Secondly, the conceptual ambiguity of the unnatural/natural dualism increases considerably in the case of agricultural nature, which has already undergone thousands of years of modification under domestication. The historical and material differences between domesticated and wild nature belie the easy classification of domesticated plants as natural, and other attempts to interpret the claim of unnaturalness through this framework have ultimately found against ‘white’ environmental concerns. Thirdly, the ubiquity of appeals to nature for moral authority in the debate

obscures the significance of the philosophical issues at stake. Discourses of naturalness play a significant role in sustaining positive representations of genetic engineering. Industry public relations and other pro-biotechnology communications emphasise the similarity of contemporary biotechnology to previous domesticatory practices, and with natural evolution. These associations are exemplified in the adoption of particular terminologies to denote the technology in lieu of others. A reassuring vision of genetic engineering as the natural evolution of domestication at once counters the charge of unnaturalness, positions the technology as inevitable, and justifies its assessment under permissive regulatory frameworks. This vision conflicts, however, with its parallel positioning as a revolutionary technology, which is necessary to the legal claim to patent protection and the market claim that genetic engineering will solve complex global problems. The tension between metaphors of evolution and revolution, and similarity and difference, is again resolved by recourse to particular domesticatory, evolutionary and cultural histories, and by the retroactive recasting of natural history in purely genetic terms.

This naturalisation of genetic engineering technology is not just emblematic but constitutive of the debate about biotechnology. Appeals to nature's authority are rhetorically powerful enough to influence the outcome of debates, where "[w]hich uses of 'nature' and 'natural' – and more significantly, *whose* deployment of these – become, over time, the winning arguments in media and public controversy about 'appropriate' and 'acceptable' uses of genetic research and biotechnology applications" (Hansen 2006: 832, original emphasis). Additionally, the evolution/revolution tension within the naturalisation of genetic engineering highlights an important element to the task of interpreting philosophical concerns about nature. The nature that is intended to be protected by white environmentalist protest and the nature that is used as a source of legitimacy by both sides is *domesticated* nature, and domesticated nature has not traditionally counted as 'nature' proper, as demonstrated by the difficulty of finding a place for it in natural/unnatural binaries. The designation 'nature', and the positive value attributed to it, has traditionally been reserved for wild nature and those elements of nature that lie outside the orbit of our direct control. Up against the biotechnologically produced plant, however, the conventionally domesticated plant appears as more natural. It is this comparative naturalness that makes evolutionary accounts of genetic engineering so reassuring. Two conclusions are apparent from this discussion. First, the controversy about genetic engineering in agriculture mobilises the concept of nature in ways that effectively reframe domesticated nature as natural. This reframing invokes the natural value of domesticated nature and upsets the traditional value split between wild and domesticated nature in popular and environmental ethics. Second, philosophically-based objections to genetic engineering can be read as an articulation of this

natural value and the complementary assertion that, while genetic engineering may share many qualities with other domesticatory practices, the domestication of nature, like interferences with wild nature, has a moral dimension and, potentially, a moral limit.

The naturalistic fallacy

The concept of nature appears to have retained its moral authority despite long and comprehensive critique of its capacity to fulfil this role (Daston 2002; Castree 2004). Popular appeals to nature for precedent are still effective in granting authority and universality to the social and political arrangements in question, and so are a powerful recourse in any controversy: “[a]lmost every ideology seeks to sign up nature for its cause, to bolster its shaky political credentials with nature’s authority” (Daston & Vidal 2004: 11). A prominent example of the naturalisation of social arrangements is the transposition of Darwin’s thesis of the ‘survival of the fittest’ in natural evolution into laws of human society through social Darwinism. Within genetic engineering debates, the authority of nature is again invoked in protests that the technology and its products exhibit and represent a morally significant level of counter-naturality. These arguments are concerned with the conceptual implications of material ‘breaches’ of nature on a number of counts: crossing species boundaries; disregarding evolutionary timeframes; bypassing regular modes of organism reproduction; legally recognising living beings as human inventions; broadly, that genetic engineering ‘interferes’ with nature and so is unnatural. By appealing to ideals of natural states, even agricultural ones, these concerns are subject to the broader problems of appealing to nature for moral authority as a discursive practice. First, it short-circuits proper examination of the issues and “pre-empt[s] further questioning or scrutiny by supplying a blanket justification for a particular situation, state of affairs or phenomenon” (Hansen 2006: 827). Second, nature itself is not always morally good but rather “[m]any natural substances are harmful; many of our natural tendencies and reactions, such as jealousy and aggression, are not normally thought morally praiseworthy; many natural events, such as earthquakes and hurricanes create destruction and suffering, and are indeed usually labelled natural disasters; many natural organisms cause pain, disease and death” (Straughan 2000: 164). Third, appeals to nature for moral authority fallaciously conflate natural and moral orders.

The main reason that ‘naturalness’ is cited to bolster both objections and approvals to genetic engineering is because nature, generally, implies goodness. Thus, “[u]ses or constructions of ‘nature’ are inevitably and invariably ‘ideological’ in the sense that they ultimately serve the purpose, as all public discourse, of presenting particular views, understandings and interests as being ‘for the common good’, ‘universal’ and ‘right’”

(Hansen 2006: 813). If an entity is claimed to be natural, it is implied that it is wholesome, healthy, and innately good. The natural is something that should be pursued or, in the very least, should not be prevented. And if naturalness is unproblematically positive, then unnaturalness is assuredly negative. The natural is conflated with good, and the unnatural is, by definition, against the order of nature; corrupted, dangerous and unwelcome. A common criticism of philosophical objections to genetic engineering is that they are articulated through the claim that genetic engineering is unnatural and is to be opposed, and so they rely on a direct and simplistic correlation between what is natural and what is good, and between what is unnatural and what is unwanted, perverse, or morally undesirable. If unnaturalness is accepted as a reason for rejecting genetic engineering, then the relationship between the unnatural and the morally wrong is more than simple association; one has in fact become a synonym for the other. A claim in favour of something on the basis that it is natural, and thus inherently good (or, in this case, against something that is unnatural, and thus inherently to be avoided), is regarded as an instance of erroneous logic that is commonly referred to as the naturalistic fallacy. In conflating 'natural' with 'good', this fallacy derives a statement of value (moral goodness) from a statement of fact (the naturalness of a thing) without due justification. In short, to commit the naturalistic fallacy is to derive what ought to be from what is.

The charge of committing the naturalistic fallacy is used to rebut ethical conclusions that appear to have been drawn from factual statements about nature. It is commonly cited in the field of evolutionary psychology, where the discovery of the natural function or evolutionary advantage of a particular behaviour can appear to have implications for the ethical status of this behaviour (Wilson *et al.* 2004; Curry 2006). The law judges a person less harshly if their crime was one of passion, as it is understandably 'natural' to respond angrily and even homicidally to adultery and betrayal. However, if rape, as one controversial example, is found to confer an evolutionary advantage, and this evolutionary advantage confers upon it a sense of 'naturalness', does this have ramifications for its treatment under the law? Evolutionary psychologists protect themselves from such potentially controversial implications of their findings by citing the naturalistic fallacy. The fact that a behaviour has been naturally selected for and confers an evolutionary advantage does not automatically provide it with a moral justification. It would be a leap from fact to value, and so an instance of the naturalistic fallacy, to claim that it does.

This definition of the naturalistic fallacy comes from David Hume (1739), although the term 'naturalistic fallacy' was actually coined by G.E. Moore in *Principia Ethica* (1903) to

describe a slightly different problem⁴⁸. For Moore, the naturalistic fallacy is committed when ethical characteristics, like ‘goodness’, are treated as identical to natural properties, like pleasure or a particular colour. The reason it is a fallacy to claim that natural is good (*ergo* unnatural is bad) is not because there are no associations to be made between the natural and the good (or the unnatural and the bad) but because goodness as an ethical property is indescribable and cannot be reduced to or reflected in a ‘natural’ property. Moore’s fallacy points to the impossibility of reducing ‘good’ to ‘natural’ because they are metaphysically incompatible properties. On the other hand, Hume’s fallacy is concerned with the robustness of the logic used to come to an ethical conclusion. It critiques the structure of an argument that jumps from a factual premise (say, genetic engineering is unnatural) to an ethical conclusion (genetic engineering is wrong). If there are no further premises about either genetic engineering or unnaturalness that relate to the ethics of either of them and from which an ethical conclusion can be drawn, then the claim that genetic engineering is unnatural and thus is morally wrong does commit the fallacy as described by Hume. Although it is Moore’s version that carries the name of the fallacy, his concept is not what is usually referred to when the fallacy is invoked, and is often ignored or deliberately put aside in favour of Hume’s account. However, both versions seem to show that there is no philosophically justifiable basis for the claim that the natural is moral, and this is the principal concern for those who reject the claim that genetic engineering is unnatural and thus wrong. If those who charge this claim with committing the naturalistic fallacy are doing so in Moore’s sense, they are asserting that the claim is wrong because it mistakes the property of ‘goodness’ with natural properties, in this case, nature as a whole. But Moore is really not saying much about ‘nature’ at all, rather he is making the relatively subtle semantic point that an ethical property is metaphysically independent from any natural properties. As these natural properties also include the sensation of pleasure, Moore’s version of the fallacy would be equally valid if used to counter the claim that genetic engineering was wrong if it caused terrible pain, though there are not many who would find fault with this conclusion. To the extent that Moore’s fallacy is the one referred to in responses to the idea that genetic engineering is unnatural and thus wrong, his claim that ‘goodness’ cannot be equated with the ‘natural’, while quite catchy, is evidently misunderstood as saying something in particular about the value of non-human nature.

Hume’s fallacy holds more promise for the rebuttal of the idea that genetically engineered organisms are unnatural and, thus, undesirable. Hume’s philosophical claim is that

⁴⁸ The naturalistic fallacy is said to have been described by Hume and named by Moore but the claims made by each philosopher are quite different, and it is historically inaccurate to unify them under the one title (Curry 2006).

statements of value cannot be exclusively derived from statements of fact. In this case, assuming that the unnatural status of genetically engineered organisms is accepted as fact, 'genetic engineering is unnatural' sits in a deductive argument as a factual premise. If the conclusion drawn from this lone premise is that genetic engineering is undesirable, then the argument indeed commits the naturalistic fallacy – an ethical conclusion has been drawn from a factual premise. But the key word in Hume's claim that statements of value cannot be exclusively derived from statements of fact is 'exclusively' (Wilson *et al.* 2003). Hume is not saying that there is no relationship at all between what is and what ought to be, just that what ought to be cannot be derived *exclusively* from what is. If another premise is included in the 'genetic engineering is unnatural' argument, an ethical premise that does the work of identifying unnaturalness as the cause of some form of harm, and establishing that this form of harm is wrong, the argument can validly produce an ethical conclusion. Indeed, rather than rejecting wholesale the idea of 'is' as 'ought', "[e]thics can even be regarded as a system designed to convert is into ought" (Wilson *et al.* 2003: 671). Environmental ethics in particular looks to the 'what is' of ecological systems to derive what ought to be⁴⁹ (Foltz & Frodeman 2004: 4). In the context of public debate these converting steps may be omitted or unreported, leaving proponents of the view that genetic engineering is unnatural open to the charge of committing the naturalistic fallacy. The 'sound-bite' arena of the debates, an anticipated lack of popular philosophical literacy, and the articulation of concerns about naturalness largely through survey responses to pre-composed statements, also precludes public development of more nuanced premises (Straughan 2000).

Without room for proper examination of what might count as 'nature' to survey participants, and how agreement with relevant statements might align with or contradict their other moral judgments, the statistics generated are limited in what they can say about the basis of these objections, and are easy for proponents to dismiss as falling prey to the naturalistic fallacy (Straughan 2000). However, the condemnation of genetic engineering as unnatural may be a simplistic articulation of the sense that genetic engineering affronts intangible qualities of nature in a way that is genuinely difficult to describe. Even where it may be warranted, accusing those who oppose genetic engineering on the grounds that it is unnatural of committing a naturalistic fallacy is rhetorically very powerful. It effectively short-circuits any thoughtful examination of what the implications of genetic engineering for conceptions of nature and the natural order might be. At once it renders a complex set of concerns about the materiality and meaning of the world invalid, and dismisses widespread

⁴⁹ The natural order as described by the ecological sciences provides environmental ethics with much of its basis for moral order. See Chapter Three for a further discussion of this.

political objection to a potentially unsafe technology as merely the result of a simple mistake of logic⁵⁰.

The natural / unnatural dualism

Where philosophers have made efforts to develop premises that can ‘convert is into ought’ in order to examine the concern that genetic engineering is unnatural (see Colwell 1989; Reiss & Straughan 1996; Burgess & Walsh 1998; Comstock 1998; Cooley & Goreham 2004) they have faced another hurdle – the difficulty of adequately defining ‘nature’ and the ‘natural’ and so confidently describing particular activities or objects as ‘unnatural’: “[i]n brief, what is the criterion of the ‘natural’ at work here, and how coherent is it?” (Soper 2005: 130). Certainly its opposite ‘unnaturalness’ is a vague, though clearly pejorative, allegation whose meaning is contingent on the series of conceptual binaries it forms with ‘nature’ in a natural/unnatural conceptual dualism. Against various meanings of nature, unnaturalness can denote the artificial, the artefactual, the supernatural, the perverse, the illusory, culture, civilisation, freedom, art, non-identity against nature’s authentic identity, exception versus universality, changeable versus eternal, or the perfecting facilities of technology against imperfect, brute matter. Nature is “that from which we start; change is inflicted from without”; unnaturalness is the “negative departure from the norm” (Evernden 1992: 21). Unnaturalness becomes monstrousness when it breaches significant boundaries. Critics ask: “[w]here in nature do we find DNA from a fish, a spider, a virus, or a bacterium introducing itself into the DNA of a vegetable? It was almost as if nature had drawn a line in the sand that humans could not – and perhaps should not – cross” (Boyens 1999: 20). Identification of such transgressions is not emotionally neutral, but presents as a kind of grief “at what seems to be a violation of the fantastic and incredible world in which we live” (Nuffield Council of Bioethics 1999: 7). It also manifests as a moral repugnance or ‘yuk factor’. While such emotional responses are an authentic element of moral decision-making (Midgely 2000; Streiffer & Hedemann 2005), they make unfortunate associations that equate the validity of concern about genetic engineering to the validity of similar moral outrage about unnaturalness against, for example, inter-racial and homosexual relationships. In this respect, unnaturalness is “a dangerous normative term” (Rolston 2002: 10).

The difficulty of translating concerns about unnaturalness into clear, concrete, and defensible arguments has led to their rejection by proponents, by other opponents who

⁵⁰ This is not to refute Hume’s observation that there are particular ways to construct arguments that can render them unsound. Rather it is to suggest that in this case this may not be what is at stake or, at least, that there is too much at stake to cut short further examination of a contentious claim with the charge of committing the naturalistic fallacy.

would rather rest their critiques on more solid ground (Meyer 2000; Reiss 2001; Meyer 2006), and by philosophers who ultimately regard the concepts of natural and unnatural as too diverse and nebulous to say anything meaningful⁵¹ (Reiss & Straughan 1996; Comstock 1998; Burgess & Walsh 1998; Cooley & Goreham 2004). Nature is “that most semantically unruly and politically ambiguous of signifiers” (Castree 2004: 194). It is particularly problematic to locate and protect what is natural within what is domesticated; many concepts of nature and naturalness are not applicable to the agricultural setting (Lammerts van Beuren & Struik 2005). Domesticated nature is an imprecise mix of natural and cultural elements that makes it difficult to find its ontological place as one side of the binary or the other, particularly in the most prominently examined binaries of natural/artificial and natural/artefactual. The naturalness of domesticates seems definitive, however, in the natural/supernatural dualism, in which nature is used to denote all that is observed to exist in the universe though still having an opposite in the supernatural – the realm of God or other deities. This version of unnaturalness also allows consideration of the near-synonymous claim that to genetically engineer is to ‘play God.’ The notion of the natural as everything other than the supernatural is clearly a ‘person-inclusive’ conception of nature (Burgess & Walsh 1998). This definition does not single out wild animals, trees or wilderness as particularly natural; it simply refers to all that is subject to the descriptive laws of nature. It is in this sense that the naturalness of all domesticated nature is assured: “[t]he corn which men raise for food grows and produces its grain by the same laws of vegetation by which the wild rose and the mountain strawberry bring forth their flowers and fruit” (Mill 1904: 9). While this definition of nature is both widespread and familiar (Mill 1904; Cooley & Goreham 2004; Siipi 2004), it really offers no way to respond coherently to the ethical and ontological issues raised by gene technology. If the only thing that is unnatural is the supernatural, then humans and all human activities are natural and the non-natural is only what occurs as a result of interventions by God, such as miracles or ‘signs from above’. If we follow the admittedly weak premise that all unnatural things are morally wrong, then the ramification of unnaturalness is that all of God’s miracles are bad and we have some moral obligation to rid ourselves of them (Cooley & Goreham 2004). But there are other ways that the unnatural can find its way into nature-as-everything. The natural/supernatural duality is a hierarchy in which the supernatural has authority over the natural, and the order and functions of nature are subject to the will of an external authority as the author of nature, or the Creator of everything. In the overtly religious interpretation, nature is necessarily

⁵¹ Bernard Rollins (1996: 535) describes concerns about naturalness as ‘[s]purious ethical issues’ that are ‘empty of content’ and have received attention only by being ‘the most shrill and dramatic articulations’ of the problems faced.

deferent to God and His design. In the ostensibly secular explanation, it is the laws of nature, including the process of evolution, that wields authority. Hence, if a thing is seen to violate either the laws of nature or the will of God, the charge of unnaturalness arises. It is this notion of the unnatural that is commonly mobilised in fervent opposition to (male) homosexuality, which is described as ‘unnatural’ because it uses an organ or instrument or thing in a way that is contrary to its principal purpose or function (Leiser 1997).

The sentiment that genetic engineering is unnatural in this sense is captured by the declaration that if God, or evolution, ‘wanted’ a tomato to be made up of fish genes so that it could tolerate the cold, He or it would have made the tomato that way already (ignoring here the deep misunderstanding of evolutionary mechanisms that underlie this reasoning). If things in nature are as the supernatural has made them, then humans must be as God, or evolution, has wanted them to be. All human activities are undertaken according to the function set out for us. These activities would have to include domestication, genetic engineering, and even homosexuality. There is also another way that genetic engineering is imagined to be natural in this sense. Just as the supernatural is seen to give the natural its function, humans give domesticated plants their function. Even though it may seem that genetically engineered plants are being used in a manner contrary to their supernatural-given function, they are not being used in any manner contrary to the function that humans give them, that is, to produce food in an efficient and economical way (Cooley & Goreham 2004).

The idea that humans give domesticates their functions and can therefore determine what is right for them is not uncontroversial. A commonly encountered sentiment that is often conflated with the unnaturalness claim is that to genetically engineer is to ‘play God’. The authority of nature that is represented here is one that is derivative of God’s authority as its author: “the most important value at stake when we look at the earth and at those who work is the principle that brings the earth back to her Creator: ...*the earth belongs to God!* It must therefore be treated according to his law” (Pope John Paul II 2000). The respect owed to nature as God’s divine creation would limit the scope of human intervention, and clearly rejects assurances that genetic engineering is as natural as previous methods of domestication, or that humans have the right to determine the function of other parts of nature. In essence, the charge of ‘playing God’ is an appeal to humility in the face of God and toward nature as His Creation (Bartlett 2005; see also Noble 1999). What is at stake is the integrity of the natural/supernatural boundary, which is in danger of being breached by humankind’s hubristic endeavours. In this sense, it is effectively an expression of Christian virtue to refrain from implementing gene technology.

Claiming that genetic engineering is unnatural on the basis that it allows humans to circumvent the natural/supernatural order and ‘play God’ is difficult to defend (Comstock 1998). Not the least of factors working against this conclusion is the question as to whether God exists at all. Among those who are sure of this fact, there is considerable disagreement as to what His plan might be. To some, genetic engineering represents a genuine affront to God as nature’s author. This position is popular but has attracted criticism for casting human activity as powerful enough to rival God and backfiring theologically by diminishing God in the face of science and technology (Hopkins 2002). To others who adhere to a notion of nature in which all human activity is not only natural but also undertaken in service to God, genetic engineering presents an opportunity to perfect God’s creation (The Pew Initiative on Food and Biotechnology 2001; Scheitle 2005). Rather than ‘playing’ God humans are called forth by Him to participate in Creation as ‘created co-creators’ (Cole-Turner 2002). From this perspective, genetic engineering is simply another step in the natural processes of domestication and biotechnology, which have thus far proven unproblematically positive. Indeed, “[w]henever the church blesses bread and shares the cup, it encounters the real presence of biotechnology” (Cole-Turner 2002: 39).

In an era where the supernatural has ‘shrunk to a philosophical possibility’ (Daston 1998: 154), its role in ethical considerations of gene technology is appropriately limited. Further, “[o]ur natural origin does not make all our actions and outcomes natural in all different senses of the term” (Siipi 2004: 464). In *On Nature*, Mill (1904) identified and worked with two principal meanings of nature. The first is the sense of nature as everything that happens, which has been discussed above. The second is “not everything which happens, but only what takes place without the agency, or without the voluntary and intentional agency, of man [*sic*]” (p. 9). This second definition is more of a ‘person-exclusive’ sense of nature (Burgess & Walsh 1998), and Mill’s description of this second kind of nature is broad enough to account for both the artificial and the artefactual. The natural/artificial dualism opposes that which is human made with that which is not. Nature in this sense may still refer to our human biological natures, but is primarily defined by the absence of humanity and human-made objects. The unnatural, then, includes all human-made objects, activities and contrivances. To definitively label genetic engineering as unnatural, *all* human activities must also be categorised as such. Categorising all human deeds as unnatural is unhelpful in clarifying the relative ontological status of genetic engineering over domesticatory practices, and entails the absurdity that all human action and artificiality are unethical (Cooley & Goreham 2004).

There are further definitional problems in the natural/artificial split. If nature is all that has not been touched by human activity, “no current ecosystem is really natural” (Siipi 2004:

468) as there are no areas that currently exist that are entirely independent from human activities. Oceans have traces of chemicals, forests are deliberately planted, and wilderness areas are maintained only by legal and administrative arrangement. The impact of human industrial practices is now responsible for the climate, such that all of what we previously referred to as natural is now no longer exclusively so (McKibben 1990). In practice, the natural/artificial split can only be supported if total naturalness and total unnaturalness (or total artificiality) are understood as abstractions at either end of a continuum. Although 'pristine' nature may now be hard to find, nature that has been only slightly or partially disturbed does still make up the majority of the earth's terrestrial surface (Rolston 1999b). Hence, "[e]ven if no area is (any longer) natural in the sense of being totally independent of humans, some places are more natural than others" (Siipi 2004: 469). It may be arguable as to whether there is any 'pristine' nature left in the wild, but not that there is very little to be found in the agricultural landscape. Although the agricultural field and its plant composition is relatively unnatural, its soil properties and the vast majority of the plant's genes would actually be relatively natural (Siipi 2004). Genetically engineering a crop plant, then, makes its genetic make-up more artificial than it was previously, though nudging the domesticate slightly further in the direction of unnatural is not regarded as enough to condemn gene technology. The 'matter of degrees' produced by the natural/artificial continuum may allow for relative descriptions of an entity as more or less natural than another, but further criteria are needed in order for this assessment to be meaningful. There must be particular and describable qualities of nature that, when amended, lost, or gained, will move entities or composites of entities in small (or even large) increments along the natural/artificial continuum.

The natural/artefactual split, which sets intentionally created objects against naturally occurring entities, faces similar dilemmas. There is a question, however, as to whether pre-biotechnological domesticated nature can definitively be described as intentionally created, given its contingency on natural factors that lie outside human control. The engagement of the field of environmental ethics with the natural/artefactual ontology in developing theories of value in nature has been extensive enough (Katz 1993; Lo 1999; Katz 2002; Siipi 2003) and, in some cases, specific enough (Lee 1999) to provide a possible basis for a meaningful interpretation of the unnaturalness claim. To this end, the ontological status of domesticates and biotechnologically produced organisms in relation to the natural/artefactual dualism is examined in Chapter Five.

In objections to the crossing of species boundaries, the unnatural presents as monstrous, perverse, diabolical. Popular myth of the scientifically created monster is grounded in literary tradition, chiefly Mary Shelley's *Frankenstein* (1818), which has provided the

primary metaphor for opposition to genetically engineered crops, but also notably H.G Wells' *Island of Dr Moreau* (1896). The Frankenstein metaphor is more than a cautionary tale against laboratory hubris in which creatures created by bypassing natural methods of reproduction (biotechnology crops) take on a life of their own and ultimately bring about our demise (through their uncontrollable escape into the wild ecosystems). The mixing of organic parts and identities represents a "deep and threatening disorder" (Midgley 2000: 10) to the 'natural' order in the world, and appeals to nature to protest the transgression of species boundaries assume a natural=order/unnatural=disorder binary. This association of both the natural and the good with the quality of order points to one of the key reasons that nature is a powerful source of moral authority, that is, "the inherent authority of all order in the face of chaos" (Daston 2002: 411). Morality and nature have a "kinship as *orders*, whether hidden or manifest" (Daston 2002: 411). Order, in this case, is represented by the reliable organisation of evolved life into the ordered hierarchy of kingdom, phylum, class, order, family, genus and species. Critical treatment of concerns about crossing species boundaries customarily challenge the stability, and thus the moral import, of this ordering with three main destabilising factors. The first is that the complexity of speciation means that there is a lack of consensus in the scientific community on a consistent species concept, with somewhere between nine and 22 definitions in use (Robert & Baylis 2003). This conceptual multiplicity is taken as evidence that there is no longer such a thing as a species at all, although researchers in the field of evolutionary biology have regarded this proclamation as premature (Rundle *et al.* 2001). The second factor is the fact of evolution itself, and the inherently mutable nature of species over (evolutionary) time. As a fragile, temporally contingent conglomeration of traits, a species has no solid claim to the fixed ontological identity defended in objections to crossing species boundaries. The third refutation of species transgression as a moral issue is made by reference to the regular occurrence in nature of gene transfer between species, or horizontal gene transfer, admittedly mostly single-celled organisms, with some rare exceptions. Whether this logically endorses genetic engineering as natural is questionable, not least because naturalness is "relative to the agent who is performing the action. It can be natural for fish to live underwater without it being natural for humans to live underwater. Similarly it can be natural for bacteria to move genes across species boundaries without it being natural for human beings to do so" (Streiffer 2003: 37). The collapse of all moral responses to crossing species boundaries into only two possibilities – either it is unnatural and wrong or there are no boundaries to cross (Zwanziger 2003) – is revisited in an analysis of the contribution of the field of environmental ethics to the issue of species transgression in Chapter Four.

The claim that genetic engineering is unnatural is typically resolved by academic, expert and popular examinations in one of three ways. The first rejects the validity of unnaturalness and the natural/unnatural distinction either because the lack of clarity about what the terms actually refer to allows them to be used with great frequency and, with the aid of the naturalistic fallacy, to support political statements, personal tastes, and “important and highly contentious moral conclusions” (Burgess & Walsh 1998: 397), or because they have embraced a fully secular definition of nature as everything in the universe, with no opposite⁵². The only issue of concern is the plausibility of the factual claims made by biotechnology. The second conclusion accepts that genetic engineering is unnatural in the sense of being artificial, but points to the unnaturalness of all human-directed activities – in particular, farming and food processing practices and the twentieth century breeding of domesticated plants – to show that this label is descriptive only and has no moral dimension. The third way that the unnaturalness claim is resolved is by drawing attention to the continuity of genetic engineering with previous domesticatory practices and the continuity of both of these with natural processes. Genetic engineering is again presented as merely another, more accurate, method of domestication, and even as one whose products are in some cases *more* natural than previous plant varieties that require the use of chemical biocides. Framing genetic engineering as natural is also achieved through the simple inversion of natural/unnatural binaries. Natural=identity/unnatural=non-identity and natural=eternal/unnatural=mutable orderings are reversed when the fluidity of species over time, the scientific uncertainty about species concepts, and the existence of horizontal gene transfer in nature are brought to the fore in order to naturalise biotechnological transgressions. This method of neutralising the unnaturalness claim features strongly in the adoption of particular terminology that reinforces associations between contemporary gene technology and previous, morally unproblematic, ways of using and intervening in nature for agriculture.

Gene technology terminology

Genetic engineering involves the transfer of DNA material between life forms, with the intention of engineering qualitative changes in the external physical characteristics of an organism. In media reports, scientific papers, academic articles, administrative and regulatory records, and promotional material, a range of distinct terms are used to describe this technology. Genetic manipulation, genetic engineering, biotechnology (specifically,

⁵² The Nuffield Council of Bioethics report *Genetically Modified Crops: the ethical and social issues* presents the argument that, because everything in the laboratory and in the field works according to natural process, the natural/unnatural distinction is “one of which few practicing scientists can make sense” (1999: 15).

agricultural biotechnology), genetic modification, transgenic technology, recombinant DNA (r-DNA) technology, life sciences, and gene or genetic technology are used solely, in partnership, or interchangeably to denote the same techno-scientific process in which the genetic material of an organism is deliberately altered through DNA insertion or manipulation at the molecular level to make that organism more useful for human-determined purposes. The differential adoption of terminologies by players in the debate has a significant role in representing the technology as either similar or different to previous domesticatory practices in scope and intent. While advocates of the technology tend to encourage the use of terms that naturalise the technology and reject those that radicalise it, the reverse is true for opponents who use terms that draw attention to the differences between conventional and biotechnological domestication. This section will critically examine the associations that particular terminologies make with other objects, activities and agendas, with attention to the effect of their adoption and how well they represent the material processes they signify.

The term 'biotechnology' was originally used to describe the utilisation of naturally occurring biological processes in the manufacture of food or industrial products. What is called traditional biotechnology relates to the use of such processes for human purposes, for example, the exploitation of micro-organism functions in the production of beer, wine, cheese, yoghurt, and in the making of bread. Less commonly, it also refers to the manipulation of living organisms through the original domestication of plants and animals. The term was reintroduced in the early 1970s in reference to the r-DNA techniques that were developed following Watson and Crick's description of the molecular structure of DNA in 1954. In the Convention on Biodiversity, biotechnology is defined as "any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use" (UNEP 1992: Article 2). Whereas traditional biotechnology engaged with biological processes at the level of the cell, modern biotechnology intervenes at the molecular biological level of genetic material (Hellsten 2002). Since its recent reinstatement, 'biotechnology' has become one of the terms most commonly used to designate the practice of the technology. The broad meaning of biotechnology as the purposeful human use of the qualities of living organisms requires further clarification to be descriptively valuable, hence its dissection into the temporal and functional manifestations of 'traditional' and 'modern'. But this does little to elucidate what is particular to genetic engineering technology. Moreover, 'modern' biotechnology also relates to other non-recombinant uses of genetics in scientific plant breeding, such as cloning, the use of DNA markers in breeder selection processes (Gepts 2002), and the generation of genetic mutations through chemical and radioactive means. Importantly, the

discursive association of biotechnology with what are commonly considered natural, or at least morally incontestable, practices of bread, wine, and cheese making is frequently cited by proponents of the technology as proof of both its safety and naturalness. The political implications of this association are only emphasised by the allusion to technological inevitability that is conveyed by the 'traditional' and 'modern' distinctions. In this sense, the term 'biotechnology' is less descriptive than constitutive, working to legitimate the technology by situating it within a linear sequence of linked developments that are broadly acknowledged as progress and improvement. Biotechnology is what we have already done, modern biotechnology is merely more 'sophisticated' (Mannion 1998: 60).

The suitability of 'biotechnology' is also limited by its terminological association of the businesses that produce it, and which do so across a number of industry fields. Biotechnology also describes the medical sector of genetic research and development, which currently faces its own set of moral and technical considerations in the use of the technology. Accordingly, modern biotechnology is subject to another set of distinctions – the divisions of 'red' biotechnology (medical), 'green' biotechnology (agricultural), and 'white' or 'grey' biotechnology (industrial substances). This schemed shorthand distinguishes between the research, development and application of the technology in each sector, which are frequently administered from the same or associated companies. The introduction of 'green' as an identifier of the technology in agriculture, though, is not merely expedient, as the term has a pre-existing presence in the field as a designator of organic agriculture and its associated political representations. 'Green' biotechnology has developed seeds that are functionally and commercially linked to herbicide applications and which have been opposed by 'green' agriculture. With this conflict in mind, the term 'agricultural biotechnology' is better placed to depict the activities of this sector. The term 'modern agricultural biotechnology' is in essence an umbrella term for a set of industry practices that employ the science of genetics in the production of agricultural commodities, but is routinely used as a descriptive designator for the technology.

Given its significance to the actual technical process of genetic manipulation, the label 'genetic' ought to be a component of an effective representative term for the technology⁵³. It is just one element that has been lost in the corporate repositioning of the pre-biotechnological seed, agri-chemical and pharmaceutical industries, as the 'life sciences' industry. As a descriptive term, 'life sciences' has been criticised for its conceptual reduction of the phenomenon of life to the molecular level – to the neglect of greater

⁵³ The term 'genetics' is also somewhat pluralistic, referring to a division of biology that deals with heredity, the manipulation of molecular material in order to alter hereditary characteristics, and the paradigm of science within which the activities of biotechnology are situated (Van Dijck 1998).

biological and ecological relations and developmental processes (Kevan & Trevors 2003) – and for the deterministic overtone that both genes and the technology can control life processes (Shiva 2000b; Bowring 2002). The more popular descriptor of the technology, however, is ‘genetic modification’, which came into use in the late 1980s to supplant both ‘genetic engineering’ and ‘genetic manipulation’ in government and industry literature pertaining to the technology⁵⁴. The acronym GM, or GMO, to denote a genetically modified organism has been well established in the regulatory framework, and was its own entry in the Oxford English dictionary in 1999. The move to genetic modification as a descriptor has been openly opposed by those who voice concerns about the ecological and moral ramifications of gene technology (Anderson 2000; Tokar 2001). Whereas the term ‘genetic engineering’ implies “outspoken [human] intervention in nature”, genetic modification is interpreted as “a more neutral terminology” (Hellsten 2002: 54) that suggests only a “slight adjustment” of existing states of affairs (Cook 2004: 20). Genetic modification makes historical associations that are similar in their effect to the normative connections made by the term biotechnology while remaining uninformative in terms of explicating the actual nature of a specific and highly specialised technological practice. ‘Modification’ denotes a generalised process in which any organism of any era undergoes some change through any means that results in an alteration of the sequence or makeup of its genetic material. As proponents of the technology often point out, under this definition humans have been engaged in the ‘genetic modification’ of their environment since the dawn of civilisation through the original domestication of plants and animals and, in particular, through the scientific plant breeding programs dating from the first half of last century. Hence, genetic modification is “an old agricultural practice carried on by farmers since early historical times” that has recently been “improved by technology” (Uzogara 2000: 179). The process of evolution depends on the mechanism of heredity – which we now recognise as DNA – and proceeds *via* the conveyance of information that is altered over time according to the selection pressure exerted by the environment. To label both this progression and the technology as ‘genetic modification’, and then to draw on the naturalness of the life process of evolution to illustrate what is particular and, by inference, necessarily sound about the technology, is a circular exercise. On this basis, genetic modification is identified as “a definite misnomer” (Gepts 2002: 1781; Nelson 2005).

By emphasising the continuity between the contemporary technology and all other previous ‘natural’ or ‘artificial’ processes that have resulted in the modification of genetic material, ‘genetic modification’ offsets fears about the risk posed by deliberately released organisms,

⁵⁴ It has also given way to “genetic improvement” in some public relations materials (Yapa 1996).

and diffuses one of the more prevalent moral arguments against the technology – that it crosses species barriers. It is “good PR speak precisely because it continues the fiction of gentle transformation and gradual, all but imperceptible change traditionally associated with agriculture and culture in general” (François 2003: 47). Proponents draw on the legitimising association of ‘genetic modification’ with naturally occurring and human-directed hybridisation of species, and the uncontested benefits that this modification has delivered. The natural ‘genetic modification’ of plants by the transfer of genetic material *via* bacterial and viral organisms is similarly referenced. Given the strong correlation that the term ‘genetic modification’ makes between the technology and other genetic changes that have previously elicited no moral concern, it is not only uninformative as a descriptor of the technology, but its adoption supports a clear technological agenda. The establishment of historical continuity and a degree of definitional obfuscation is interpreted by objectors as a deliberate diminishment of the role of human intentionality fore-fronted in the use of the term ‘genetic engineering’ (Levidow 1995; Tokar 2001; Levidow 2001). In contrast to the naturalising bias of ‘genetic modification’, the primary metaphor of ‘genetic engineering’ is industrial (Bowring 2002). It emphasises historical associations with the ‘engineering ideal’ of completely reducing life to human control that characterised molecular biology at its 1930s inception (Regal 1999). Continued promotion of the technology as “precise, controllable and predictable” (Harlander 2002) draws on this association, even while the term ‘genetic engineering’ is no longer common.

Biotechnology advocates have abandoned ‘genetic engineering’ for the more neutral ‘genetic modification’ and, in public relations material, the value-laden ‘genetic improvement’ (Levidow 2001). Activists and those critical of the technology have deliberately retained the term, considering it more representative of the intention and effect of applying r-DNA technology within its current commercial context. By identifying a teleological actor in the process, ‘genetic engineering’ comes close but still does not conceptually express what is unique about the technology (Meyer 2006). Irrespective of its rhetorical import, an accurate definition would need to differentiate the process of gene technology from previous methods that have been employed in the development of agricultural seed products in order to be a meaningful descriptor. A key point of differentiation is that the transfer of genetic material *via* the technology bypasses the plant’s ordinary method of reproducing through sexual means. Thus, it results in an organism with characteristics “outside the normal range that sexual recombination allows” (Ogden 2001: 339). The fact of this hybridity underlies the proposal that ‘transgenic technology’ is the only term that adequately conveys what is particular to the technology – that is, the crossing of species boundaries (Ogden 2001).

Were the technology confined to the use of genetic material from other species, this definition may well suffice. Yet while the so-called first generation of plants produced using the technology were transgenic in this sense, some second generation developments are working to augment the existing genetic characteristics of an organism rather than seeking their ends by the insertion of 'foreign' DNA (Myskja 2006). A new set of terminologies to explicate the presence and extent of transgenic DNA have been specifically introduced to allay such concerns and to address the argument that such organisms would never arise through natural evolutionary processes (Nielsen 2001). The categories of 'intragenic' (to denote the use of the organism's own genetic material) and 'famigenic' (where the genetic material comes from species within the same family) are identified as kinds of organisms that may have arisen, if not through natural evolution, then certainly through conventional breeding. The labels 'linegenic' (within the same lineage), 'transgenic' (unrelated species, including cross-kingdom) and 'xenogenic' (laboratory designed genetic material) categorise the technology in terms of the origin of the genetic material that is inserted. The purpose of this detail is to lend transparency to the technology, and make it more easily subject to meaningful distinctions from which its moral implications can be determined (Myskja 2006; see also Madsen *et al.* 2002).

This multiplicity of terms is useful for identifying the genetic distance between host and the source of genetic material, that is, for explicating the origin of the genetic makeup of the generated organism. In terms of conveying what the technology procedurally and materially entails, however, it remains uninformative. Even the seemingly straightforwardly technical designation of the r-DNA technique is inadequate. Genetic engineering or genetic modification can "refer to the deletion of a gene from an organism as well as the insertion of a gene into an organism, whereas 'recombinant-DNA' implies only the insertion or addition of a gene (DNA sequence) to an organism" (Hindmarsh 2005: endnote 388). As it stands, three features are apparent to the task of identifying the particular characteristics of the technology. The first is its method of forcibly introducing genetic material through the use of an organic vector or the firing of tiny pellets into the cell nucleus (Anderson 2000). It is these methods that allow for the breach of the biological barriers otherwise presented by sexual reproduction. Genetic recombination through sexual means requires the "fertilisation of an ovule in a female parent by a sperm cell contained in a pollen grain produced by the male parent" (Gepts 2002: 1781). With this, and the problematic of breaching species boundaries, in mind, Clark & Lehman (2001: 3-4) argue that "the distinguishing feature of [the technology] is forcible gene insertion *per se*, not the wideness of the cross". The second attribute of the technology, which is materially related to the feature of forcible insertion, is that the location of the newly introduced DNA in the host genome is typically variable and

unknown; a feature of the technology that contributes greatly to its experimental nature. A consideration of ‘forcible insertion’ as a necessary component of an effective definition does two things. It implicates the human as the ‘enforcer’, the teleological actor of the procedure, and, in association with ‘genetic material’, it implies the third and quite obvious feature of the technology – the molecular scale of the procedure. ‘Traditional’ biotechnology mediates biological processes at the level of the cell, and the ‘genetic modification’ of domestication and conventional plant breeding alter characteristics through sexual reproduction at the level of the phenotype of the organism. Gene technology is unique because of its molecular and cellular scale of intervention and its direct engagement at the genetic level.

The terms ‘genetic engineering’, ‘genetic modification’, ‘transgenic technology’, and ‘biotechnology’ are most frequently used across the literature. There are definite concerns about the adequacy of each term in relation to its definitional precision, the associations it makes with other activities, and the role it plays in working to normalise the technology and defuse legitimate concerns about its novelty. The purposeful introduction and popularisation of the term ‘genetic modification’, and its failure to say anything meaningful about the technology, means that, except for necessary reference to GMOs (genetically modified organisms⁵⁵ as they have been conventionalised in regulatory and other documentation), the term ‘genetic modification’ has been avoided in this paper. The remaining terms are unable to satisfactorily act as the sole referential label for the technology, so have been employed interchangeably – with majority usage of genetic engineering and biotechnology – in the understanding that these terms specifically act as descriptors for the technology with its particular characteristics of forcible insertion of genetic material into an unknown location on the genome *via* non-sexual means, orientation to the fulfilment of humanly-determined goals, and being undertaken on the molecular scale.

Evolutionary and revolutionary visions of biotechnology

This preference for particular terminologies is a key component of the broad strategy of disguising novelty and emphasising continuity that forms a “dominant discursive pattern [that] serves the primary function of advocating biotechnology” (Burchell 2007: 50). Public relations materials (Hellsten 2002), formal and informal scientific discourses (Burchell 2007), and direct responses to the charge that genetic engineering is unnatural (for example, Prakash 2001) endorse a vision of genetic engineering as the gentle evolution of plant

⁵⁵ The accepted use of the abbreviation GM instead of ‘genetic modification’ is also “not merely a matter of communicative economy. It may also, as George Orwell pointed out in *Nineteen Eighty-Four*, distract attention from what these initials stand for” (Cook 2004: 87-88).

breeding techniques and technologies. Biotechnology is “a logical extension of the continuum of devices we have used to amend our crop plants for millennia” (Prakash 2001: 10-11), “an extension of what has been happening for 10 thousand years” (Nuffield Council of Bioethics 1999: 2), “essentially a refinement of [cross-breeding and hybridisation] methods” (Lacy 2003: 194). These kinds of associative statements are prolific in the literature and, along with the adoption of reassuring terms like ‘genetic modification’, constitute a ‘discourse of similarity’ (Burchell 2007) that is politically effective in rebutting calls for more stringent regulation, countering the charge that genetically engineered crops pose unique health or environmental risks, and trivialising consumer concerns. The neutralising effect of the similarity discourse cuts two ways. First, if people were not previously concerned about the methods and effects of conventional domesticatory practices, they have no grounds to be concerned about genetic engineering. The lack of protest against grafting or hybridisation or the use of mutating radiation to induce genetic variation in times past is thus seen to nullify contemporary protest. Second, if people *are* worried about genetic engineering, they must also be retrospectively worried about previous methods and effects⁵⁶. The associations made between biotechnology and conventional domestication are so definitive that to find against genetic engineering is to find against all selective breeding. The scope of opposition demanded by the framing of pre- and post-genomic plant breeding as ethically equivalent is thus impossibly wide⁵⁷. The discourse of similarity is based on the logic that if a qualitative change is merely an accumulation of small changes, the differences between which are otherwise imperceptible, then there is no discernible difference between the original state and the final condition. This logic is soritical; it is, at core, a paradox⁵⁸. There are quite obvious differences between early prehistoric and modern biotechnological domesticated plants, just as the sorites paradox shows that there are significant quantitative and qualitative differences between other incrementally separated original and final states. The similarity discourse embraces rather than denies the paradox to contend that there are no important differences between original,

⁵⁶ For example: “I think that if we are to fashion, at least from a philosophical point of view, a powerful argument against [biotechnology], it is going to have to be general enough to call other technologies into question, including some we have accepted as benign” (Kline 1991: 220).

⁵⁷ Even though some people who oppose genetic engineering are also worried about other standard aspects of industrial agricultural practice, such as heavy chemical use and monocultural production methods (Burchell 2007).

⁵⁸ The sorites paradox is also known as the ‘heap puzzle’ (from the Greek *soros* meaning ‘heap’). One grain of wheat does not make a heap, neither does two grains, or three, and so on to 10 thousand and beyond. But at some stage a pile of wheat is describable as a heap. Similarly, a man with only one hair is still a bald man. With two hairs, three hairs, and so on, he is still bald but at some stage he is no longer bald but hirsute. The same paradox also exists in reverse, where the removal of one grain of wheat from a 10 thousand strong heap does not mean that the remaining quantity of wheat is no longer a heap (Fisher 2000).

or traditional, or conventional and biotechnological domestication, and thus that there is no difference in their acceptability⁵⁹ (Holland 2004).

The discourse of similarity grants genetic engineering an aura of normalcy and naturalness. In some advertising campaigns, agricultural biotechnology is explicitly marketed as ‘working with nature’ (Hellsten 2002), amid the implied concession that ‘nature knows best’ (Sagoff 2003). While proponents charge opponents with committing the naturalistic fallacy, the discourse of similarity from pro-biotechnology quarters makes its own appeal to nature for moral authority⁶⁰. The main sources of naturalness for biotechnology are its soritical positioning as simply another practice in the extensive and progressive repertoire of previously unproblematic domesticatory activities, and the use of a recurring analogy between the gene transfer technique of genetic engineering and the mechanisms of natural evolution. Crossing species boundaries is not problematic because species naturally evolve and change, or do not even exist as natural categories at all; bypassing sexual reproduction is not morally important as some organisms naturally spread their genetic material directly through horizontal gene transfer; and genetic combinations created in the laboratory are not monstrous as they could also have evolved naturally through conventional plant breeding.

However, a ‘discourse of difference’ is also in operation in a competing vision of biotechnology as a revolutionary breakthrough. Rather than representing a seamless transition to a more efficient, though otherwise comparable, method, the genetically engineered plant symbolises a definitive break with the past. This representation is essential for accessing intellectual property rights on biotechnologically produced organisms, which can only be granted to novel, non-obvious innovations whose creation involves a clear inventive step. It is also crucial to maintaining the strong economic argument in favour of patents, namely, that they act as an incentive for innovation. Legitimate claims to this new form of property cannot be upheld if genetic engineering is only the ‘logical extension’ of existing methods. Similarly, the vision of biotechnology as a revolutionary leap forward authenticates its promise to be a ‘magic bullet’⁶¹ (Scott 2005) that can provide a solution to

⁵⁹ Technology tends to be assessed for acceptability using the following soritical argument: A is x / A does not differ significantly from b (or by inference, c, d, e, f and so on) / Therefore b (and c, d, etcetera) is x. A is acceptable / A does not differ significantly from b (or by inference c, d, e, f and so on) / Therefore b (and c, d, etcetera) is acceptable (Holland 2004).

⁶⁰ An examination of the discourse of the debate reveals how the language used by proponents of the technology plays a strong role in maintaining the power relationships of biotechnology disputes (Cook 2004). While some work as been done to critically examine the metaphors and ‘emotive symbolism’ employed by opponents of the technology (see Scott 2003), I follow Cook’s approach of focusing on the rhetoric of proponents because the parties arguing for the substantial move to agricultural biotechnology necessarily “require[s] more scrutiny than those to preserve the status quo” (Cook 2004: 4).

⁶¹ A ‘magic bullet’ is a technological apparatus that is able to specifically target a particular problem while leaving the surrounding areas unharmed, for example, antibiotic medication. The problem of magic bullets is not

the complex global problems of world hunger, drastically reduce chemical use in agriculture, and perform economically as a shrewd investment. Biotechnology is heralded as “the most powerful and revolutionary technique of the new genetics” (Janick 1998), “harnessing the world’s most advanced scientific thinking” (Novartis advertisement, in Hellsten 2002: 67). This positive rhetoric does not draw its authority from nature but from the grand narrative of human progress (Bruce 2002b) to resonate with our “culturally embedded sense of the steady march of enlightenment progress” (Brown 2003: 3). The tendency to describe and report biotechnological developments as ‘breakthroughs’ (Brown 2000) is one instance of correlation with the progress narrative. Like the domestication metaphor in genetic engineering (Rader 2007), the ‘breakthrough motif’ creates strong associations between biotechnology and previous, positively valued, developments, in this case, to share the ‘reflected glory’ (Cook 2004: 10) of innovations like vaccinations, antibiotics and laser surgery⁶². The moral implication, often made explicit, is that opposing this new revolutionary breakthrough equates to opposing all previous revolutionary breakthroughs from which we presently benefit. This collapse of all human innovation into one category that must either be accepted or rejected wholesale is a logic that was seen earlier in the rejection of the claim that genetic engineering is unnatural and so undesirable, because it effectively tells against all artificiality.

One way that the revolution of biotechnology is celebrated is *via* the claim that it will increase the speed with which new plant varieties can be developed, by nearly halving current time frames (Harlander 2002). The claim to increased pace is causally linked to the claim to greater precision in breeding. It is the ability to transfer only select genes from one organism to another that reduces the time taken to breed out the unwanted genes that are also transferred through sexual reproduction. In contrast to the “precise, controllable and predictable” method of genetic engineering (Harlander 2002: 162S), sexual reproduction is described as the “random mixing of the tens of thousands of genes present in a plant with the tens of thousands of genes present in another plant”. By allowing essentially the same task to be undertaken more rapidly, this revolution can simultaneously reinforce the evolutionary vision, but it has proved vulnerable to criticism on at least two fronts. The first is the question of whether the technology is able to realise this promise in actuality. The claim that the technology can accomplish faster and more accurate breeding has been criticised for underestimating the time it takes to develop new plant varieties using

that they are technological *per se*, but that they are developed within a narrow research paradigm that precludes other solutions (Scott 2005).

⁶² Through brief speeches and long proclamations, political figures follow the lead of industry in promoting biotechnology by conflating it with all other biologically-related developments that have come before it “so that it includes, and acquires the glory of, the whole history of human achievement” (Cook 2004: 12).

biotechnology⁶³ and overestimating the precision of the method in terms of introducing new genes into the right location and ensuring their proper expression following insertion. The contingency of gene expression on the external environment and the activity of other genes means that biotechnologically produced crops “require multilocation, multiyear testing, making GE more akin to classical breeding” (Gepts 2002: 1787). The second is an objection to the framing of quicker pace as a morally neutral improvement.

In a rejection of the economic equation in which time is synonymous with money and a faster pace of production is unproblematically positive, the rapidity of the biotechnology process is perceived as a subversion of both evolutionary and precautionary time frames. The fast pace of its introduction into agriculture amplifies concerns about its counter-naturality: “[s]ingle projects, introduced slowly, tentatively, and critically, would not necessarily disrupt our whole idea of nature” (Midgley 2000: 12), and evolutionary pace in favour of revolutionary speed is even preferred by those who can find no other in-principle reason to oppose the technology (see Burgess & Walsh 1998). While increased pace is characteristic of the time-insensitive nature of industrial production more generally, there are further temporal implications that are identified as being particular to genetic engineering. For example, the creation of crops in which the *Bt* toxin is always active, instead of breaking down over time as it does when used in its ‘dust’ form by organic farmers, is said to “[bespeak] an ignorance or denial of the value of time so pronounced and tenacious that ... I am tempted to call it a desperate denial of the fact of time itself” (François 2003: 56). ‘Terminator’ plants, or Genetic Use Restriction Technologies (GURTs), are engineered to be sterile and disrupt the natural temporality of seeds by substituting cyclical reproduction with permanent loss (Gold 2003). GURTs are “endlessly replaceable and permanently nongenerative” (François 2003: 53) and typical of the temporal orientation of biotechnology that prioritises for “function of product at expense of re/reproduction system processes” (Adam 1998: 214). Barbara Adam’s (1998, 1999, 2000) critique of the relationship of biotechnology to time, from the engineering of foods with ‘counterfeit freshness’ that obfuscate their temporal history⁶⁴ to the unacknowledged extent that biotechnology organisms extend the reach of corporate interests into the long term future (Adam 1998), progresses the popular point that it is unnatural to operate outside of

⁶³ This claim also uses as a benchmark the time taken for conventional plant breeding processes before the introduction of time-saving molecular markers into plant breeding practice. Molecular markers allow the early identification of whether the desired genes have been bred into the next generation. Their use allows plant breeding times to be reduced from two calendar years to just over a year for most crops (Gepts 2002).

⁶⁴ For example, the trait of delayed ripening has been engineered into melons, papayas, plums and strawberries to serve the timetable of food shipping (Harlander 2002).

evolutionary time scales. Thus the representation of biotechnology as revolutionary is at odds with one of the defining features of the evolutionary vision – its long time frame:

The expansive temporal and spatial scales that feature in studies of domestication, and the relatively rich tradition of merging social and biophysical variables...helps put the more nascent social theoretical concern with the dangers of manipulating life in much broader context. An important part of this wider contextualisation is that it gives us time—historical time, evolutionary time—to register and account for the potentialities that also inhere in these fraught encounters (Clark 2007: 67).

Yet, seemingly paradoxically, it is also from the vantage point of technological progress that the contradiction of genetic engineering as at once revolutionary and evolutionary can be, albeit partially, resolved. The idea of a technological ‘breakthrough’ contains within it reference to a problem that is to be faced, and a (future) solution that will overcome it (Brown 2000). Coupling biotechnology to its problem context means that it is not enough to critique genetic engineering without also providing robust, alternative solutions to the moral problem of world hunger. The problem/solution matrix of revolutionary visions is strongly future-oriented, while both evolutionary and revolutionary representations of biotechnology appeal to the known constants and familiar upheavals of the past. Both temporal orientations have the effect of presenting gene technology and its application to agriculture as inevitable. The discourse of similarity works by presenting “only one history of agriculture – a direct, unilateral course leading straight from the first seeds saved by humans to Round Up Ready soybeans” (François 2003: 44). The imagined evolution of domesticatory practices does not share the complexity, variability, or indeterminacy of natural evolution, but is instead presented as unproblematically orthogenetic, developing systematically on a goal-directed course, as though all future configurations of domestication lay preformed since the origins of agriculture. Because domestication is as much a culturally as a naturally contingent phenomenon, its history is easily appropriated into the narrative of progress in a convergence of evolutionary and revolutionary visions. Such a teleological interpretation of domestication depoliticises its traditional, conventional and biotechnological manifestations collectively. It erases the diverse agricultural origins, peoples, places and timescales of domesticatory past and present. It naturalises the role of capitalism in the political economy of pre- and post-Mendelian plant breeding. It also relies almost entirely on a universalised abstraction of biological phenomena in genetic terms, through which the natural world is rendered naturally equivalent and the boundaries, contexts and complexities of organismic life disappear.

Phases of domestication

While it is common for pro-biotechnological histories to present domestication as a process of cumulative practical, scientific and technological progress to the benefit of all, critical views of the same developments highlight instead the emergent roles of elites, colonial exploitation, and privatisation in plant improvement efforts (Kloppenborg 1988; Busch 1991; Fowler 1994; Pistorius & van Wijk 1999). *Contra* the soritical vision of domesticatory history as comprising small, indiscernible changes, Lawrence Busch (1991) identifies five distinct phases of Western plant domestication. Each phase is delineated by the level of intervention allowed by scientific knowledge of the time, and the institutional support for its translation into technique. The first phase is identified as starting at the beginning of agriculture⁶⁵ approximately 10,000 years ago and the emergence of the 'domestication syndrome' that differentiates domesticated from wild plants. The saving of particular seeds for replanting involved purposeful and unintentional selection of desired agronomic and culinary traits and created food plants with bigger and tastier edible parts, more compact forms, and an incapacity to survive outside the agricultural field. Over thousands of years, this process of 'mass selection' produced a vast range of place-, climate-, and culture- specific diversity of food plant varieties. The description of these highly heterogenous, geographically distributed, long term practices as one phase of history clearly serves the sake of expediency. Busch's schema is concerned with highlighting the detail of the emerging politics of domestication from modernity onwards, but the tendency to offer a truncated history that is blind to the differential adoption of breeding techniques and selection priorities serves the evolutionary biotechnology narrative well. It establishes a clear delineation between pre-and post-scientific domestication so that the 'unnatural' revolution threatened by genetic engineering is located instead at the end point of this seemingly 'natural' undifferentiated phase of domestication.

Busch's second phase started when domesticatory practices began to be undertaken by professional plant breeders in the seventeenth and eighteenth centuries, supported by new plant material from the global plant transfers that accompanied colonial expansion. Methods were no more sophisticated than farm-based breeding, as they were both undertaken in the absence of full knowledge about mechanisms of heredity, although the scientific methods adopted made professional breeding a more deliberate enterprise. Breeding was methodical and goal directed but largely advanced through trial and error, with the additional use of imported plant materials. While the grafting and hybridisation techniques of this period are

⁶⁵ Though some theorists have posited a pre-agricultural domestication (Rindos 1980, 1984; O'Brien & Wilson 1988) in which the foraging activities of pre-agricultural people exerted a selection pressure on wild food stands to produce an early domesticated phenotype (See Chapter Seven).

narrated through the similarity discourse as self-evidently unproblematic, concerns about the naturalness of these processes existed at the time. Hybrid flowers are called ‘nature’s bastards’ in Shakespeare’s *The Winter’s Tale* (1611), and grafting was considered to “trespass on the species-creating prerogatives of nature” in medieval and early modern Europe (Daston 1998: 157), to ‘vex Nature’ in Andrew Marvell’s poem *The Mower against Gardens* (1892), and to be ‘wicked’ by American apple propagator John Chapman (‘Johnny Appleseed’) of the early nineteenth century (Pollan 2001). It is similarly noted that public concern about the power of science to manipulate life in the laboratory is not specific to contemporary mistrust of biotechnology but has been present since the onset of the scientific revolution (Turney 1998).

This second phase also saw the rise of the commercial seed industry and the parallel reduction in on-farm seed production⁶⁶ (Fowler 1994). The context of agricultural mechanisation and the changing commercial presence of the farm from a source of family subsistence and livelihood to a business in service to the market, exemplified in the shift from smaller separate farms to larger consolidated acreages, allowed for commercial varieties to supersede farm varieties, and to dictate the kinds of plants that were bred. Those varieties that were easily harvested and mass planted gained dominance, just as unusual and delicate varieties were neglected. The unidirectional narrative of domestication history is insensitive to these lost domesticates, which have increased considerably in number into the twentieth and twenty-first centuries. Their foregone heterogeneous natural, culinary and agricultural value is sublimated as the (inevitable) loss of ‘genetic diversity’ in the face of inexorable progress, which continues today with the replacement of traditional with biotechnological and other modern varieties (Cleveland & Murray 1997; Thrupp 2004).

The third phase of domestication began with the ‘rediscovery’ in 1900⁶⁷ of Johan Gregor Mendel’s (1822-1884) experiments on pea hybridisation and his identification of units of inheritance in 1865. Plant breeding became guided by theory, and was advanced through academic and practical activity in the new field of genetics⁶⁸ (Wieland 2006). The end of this phase saw the triumph of commercial over farm-based breeding and the foregrounding of agricultural production efficiency in the narrative of progress. Efficiency priorities were

⁶⁶ The United States government supported on-farm experimentation by providing free seed for farms to produce their own local varieties, however, as the commercial seed sector gained ascendancy, generic seeds were provided as a welfare service rather than to encourage farm based breeding (Fowler 1994).

⁶⁷ The significance of Mendel’s hybridisation experiments were unrecognised at the time of their presentation. They were ‘rediscovered’ independently in 1900 by Hugo De Vries (1848-1935) and Carl Correns (1864-1933) and in 1906 the term ‘genetics’ was coined by William Bateson (1861-1926) (Falk 2006; Fowler 1994).

⁶⁸ Key scientific discoveries of this time included Johannsen’s 1903 creation of a ‘pure line’ that stayed true to type when propagated by seed, and the economically significant discovery in 1905 that a single gene controlled wheat rust (Robinson 1996).

consolidated in the fourth phase of domestication through the successful application of Mendel's laws to the development of the double cross hybrid, notably corn. The hybrid food plant is the domesticatory product most frequently referenced in evolutionary and revolutionary narratives of biotechnology as a previous, beneficial improvement, and the role of natural hybridisation in nature, in speciation, and in the development of early domesticates is associatively cited for the legitimacy of the 'hybridity' of modern biotechnology⁶⁹. However, food plant hybridisation in this era also secured the primacy of scientific approaches to breeding innovation and development, and marked the beginning of the successful intrusion of capitalist relations into the evolution of crop seeds (Kloppenburg 1998). Although on-farm plant breeding had become too time and space consuming for market agriculture, farmers were still able to save the next generation of seed from purchased stock. That is, the nature of seeds as self-reproductive had previously provided a biological barrier to their full commodification inasmuch as they had been otherwise commercialised. Crop hybridisation dissolved this obstacle, interrupting the physical connection between the grain and the germinant, and the farmer and the seed. The vigour of hybrid plants is restricted to the first generation, and saved seed does not breed true but tends to produce weaker crops with reduced yields. In order to retain the benefits of scientific crossbreeding, new heterotic seed stock needs to be purchased every year. With hybridisation, the dual role of seed as at once food and a means of production was effectively decoupled to secure market dependence on commercial seed proprietors. Neither was this dependence an unintended effect; scientific research on open pollinated varieties that would have retained the self-reproducing capacity of the seed remained undeveloped because of the commercial imperative in agricultural funding. The double cross hybrid⁷⁰ was developed in service to progress *qua* market capitalism (Fowler 1994; Kloppenburg 1998; François 2003).

The evolutionary vision of agriculture presents this and developments such as triticale, a totally new crop synthesised a few decades ago through the forced cross-genera breeding of wheat (*Triticum*) and rye (*Secale*), as outside their economic and political contexts. It rests on a basic analogy between these crosses and natural hybridisation, which is self-evidently 'good' as it plays a central role in natural evolution to the development of new species, and other accidental hybridisations that have proved fortuitous for agriculture. The crossing of two wild species of strawberry produced the modern, large-fruited variety (Prakash 2001),

⁶⁹ In particular, the role that natural hybridisation has played in improving domesticated varieties. Gene flow from wild relatives in close spatial proximity to cultivated varieties has been crucial to the development of, for example, contemporary soybean, sugar beet and common bean varieties (Arnold 2004).

⁷⁰ The 'double cross' crosses four 'pure lines': (inbred A x inbred B) x (inbred c x inbred d) (Smith, CW 1995).

and only 4000 years ago the unintended hybridisation of cultivated durum wheat and wild goat grass produced modern bread wheat (Damania 1997; Prakash 2001; Gepts 2004). The wide scope of the term hybrid, used to mean any mixture of different kinds, means that this analogy easily accommodates the methods of the new biotechnologies. This fourth phase includes other methods of modern plant breeding, including the use of mutagenic chemicals and irradiation on seeds to generate variation⁷¹, and specialised tissue and cell culture methods (Prakash 2001; Harlander 2002). The techniques of this phase are often cited to rebut the claim that genetic engineering represents a significant departure from what has come before, and the lack of popular outcry at the time interpreted as public endorsement of this trajectory of research and development. This logic rests on an understanding of agriculture as already unnatural, and relocates the revolution represented by genetic engineering to, at least, the beginning of phase three. Since then, “plant breeding research has moved increasingly out of the field and into the laboratory, out of the public sector and into the private sector, and out of the informal system of exchanging plant genetic resources and into a more restricted environment of intellectual property regulations” (Reeves & Cassaday 2002: 858).

The conventional plant breeding phase still continues, although is it being increasingly neglected as an area of research as biotechnology takes centre stage (Knight 2003) to become the fifth and current phase of domestication. The shift from public to privately funded agricultural research that facilitated and characterised the fourth phase is consolidated in the political economy. Universities undertake research under strict market arrangements with industry; developments are made in the context of commercial product manufacture, and the commercialisation of the seed industry is extensive, global, and driven by small numbers of large corporations, as detailed in the previous chapter. Within the political and economic context of biotechnology, and indeed driven by it, growing scientific knowledge about how to exploit domesticated nature increasingly frames nature as a readily available resource in a Heideggerian sense. Martin Heidegger’s (1954) treatise on technology contends that technology is not merely a neutral means to an end. Modern technology prescribes a particular orientation to the world that reconfigures nature in terms of its capacity to be ordered as resources. “Everything everywhere is ordered to stand by, to be immediately at hand, indeed to stand there just so that it may be called upon for further ordering” (p. 304). This supersedes any other ways that nature may have been appreciated. The world comes into awareness – indeed *exists* – only insofar as it appears to us as raw materials. In part, this reconfiguration, or ‘enframing’, relates to the scale and

⁷¹ The use of gamma radiation has created over 1800 new crop varieties since 1970 (Harlander 2002).

resource-intensiveness of modern technology: industrialised agriculture ‘sets upon’ the earth demanding and extracting resources in ways that qualitatively and quantitatively differ from the technologies of traditional agriculture. However, the enframing of nature as raw materials precedes the development of any specific technology. It is not simply an effect of technology, but an orientation to the world that is constitutive of modern technology. For Busch, the current phase of biotechnology marks “the final step in the socialization of nature, in the transformation of nature into resources” (Busch 1991: 108). The five phases of plant domestication are demarcated by a ratcheted shift toward a wholly instrumental view of the place of nature in the people-plant domesticatory relationship. Genetically engineered organisms are the “newest symbols of enframed nature” (Scott 2000: 294), and enframing of nature as standing-reserve to serve exclusively human interests is furthered by the concomitant reframing of nature in genetic terms.

Reducing biology to genetics: the loss of the organism

The discourse of similarity is built on the likeness between the intent and effect of traditional plant breeding and biotechnology, not on the equivalence of their technical methods. The recombinant DNA technique itself tends to be presented in a rudimentary, ‘black-boxed’⁷² way; indeed, attention is often deliberately deflected away from the laboratory process in defences of the technology (Krimsky 2005). As a highly complex specialist procedure, genetic engineering remains inaccessible to the lay person to the extent that “it might not help to look up in a book how the technology operates because all the explanations and illustrations in the world do not yield perspicuity” (Nordmann 2005: 5). This impenetrability lends the technology to popular description in simplified terms, which are in turn bound up in broader metaphors of what genes are and what they do. The naturalising emphasis on effect over method is maintained in descriptions of both biotechnology and past artificial and natural plant reproduction as ‘gene transfer’: “[j]ust as man in the laboratory uses various techniques to transfer genes, gene transfer in nature also takes place in various ways” (BioTIK 1999: 11). The descriptor ‘gene transfer’ appears to hold for Mendelian breeding, which is concerned with breeding for dominant/recessive traits that relate to a single gene and can only be either present or absent. For example, a Mendelian breeding process would cross and backcross a blight resistant but low-yielding wild variety with a high-yielding but blight susceptible variety until only the single gene for resistance is transferred and the high yield of the cultivated variety is retained (Robinson

⁷² ‘Black-boxing’ involves the substitution of information about detailed processes of technological workings with a simplistic picture of their result.

1996). Traditional plant breeding, however, was aimed at small qualitative improvements across a range of traits – that could be governed by single or multiple genes – through long term population and individual selection.

The language of ‘gene transfer’ has a similar effect to that of ‘genetic modification’. It naturalises biotechnology as just another method of achieving a familiar outcome. To do so, it shifts attention away from the perceptible and tactile level of the world that humans generally encounter to the invisible molecular level. Genetic engineering is rendered similar and familiar by foregrounding genetic action over individual organism interactions, and by reconfiguring the objects of nature so that the gene replaces the organism as both the agent and the primary interacting individual entity of natural history⁷³.

The reduction of biology to genetics assumes a model of life as an aggregate of genetically determined traits. This reflects the ‘central dogma’⁷⁴ of molecular biology in which genes are expressed through a unidirectional ‘decoding’ process that operates independently of an organism’s internal or external environment. The process, crudely recounted, is that the double helical structure of DNA (deoxyribonucleic acid) is ‘unzipped’ in the cell nucleus, replicated and transcribed into single strand RNA (ribonucleic acid), which is translated in the cytoplasm into amino acids that are assembled into proteins. The DNA molecule is a long string of an ‘alphabet’ of nucleic bases⁷⁵ – adenine (A), guanine (G), cytosine (C), and thymine (T)⁷⁶, while RNA contains uracil (U) instead of thymine. In the translation phase, triplet sequences of these bases⁷⁷ (eg AGU, CGA, GUC, and so on) form ‘words’ that correlate directly to the production of an amino acid, which string together in long chains to make protein, the foundation of all the structures and functions in a living organism. As there is no reverse transfer of sequential information back from protein to DNA, DNA is said to provide the ‘code’ for the creation of particular proteins and so the creation of

⁷³ This understanding of the role of genes is one with much support outside of this discourse. Richard Dawkins’ prominent book, *The Selfish Gene* (1976), describes genes as both the beneficiaries and the fundamental actors of reproduction firmly established this view in socio-biology (Sidler 2006). In environmental ethics, Holmes Rolston III has argued on this basis that genes are the “loci of intrinsic value” of life forms because they store the information that allows organisms to effect their own development. Rolston’s position has been criticised for adopting the genetic reductionist viewpoint without “critically discuss[ing] the linguistic, representative or ‘program’ view of the gene together with its social and political implications” (Rehmann Sutter 2004: 96).

⁷⁴ First advanced as such by Frances Crick in 1958 (*On Protein Synthesis*) and again in 1970 (*Central Dogma of Molecular Biology*).

⁷⁵ Held together by a ‘backbone’ of sugar and phosphate.

⁷⁶ These bases pair together to form the double helix structure only as A-T and G-C. Thus the sequence of one strand can be deduced from the sequence of the other.

⁷⁷ As there are four nucleic bases (nucleotides), there are 64 possible triplet sequences, or ‘codons’. Three instigate the start or end of a chain of amino acids, which leaves 61 codons to code for a total of 20 amino acids. Thus more than one codon can correlate to one amino acid. The number of different proteins that are subsequently produced from various combinations of 20 amino acids is enormous.

particular organisms. This idea has been reinforced by the popular and technical use of information metaphors⁷⁸ to describe the activity of genes.

A gene is the length of DNA that, once replicated, transcribed and translated, synthesises proteins that combine to form a minimal phenotypic trait in the organism⁷⁹. Genes are repeatedly referred to as a code, language, information, program, instructions, map, or blueprint of life. These information metaphors are in part an effect of the history of research collaboration between biology and computing and the continued dependence of the science of genetics on information technology (Waldby 2001; Sidler 2006), but are misrepresentative in that their popular use conflates two kinds of concepts about information (Keller 1993, 2000; Ingold 2004). The vernacular understanding of information refers to the content, or meaning of a communication between two or more entities. The information described by the central dogma in the DNA molecule is a different sense of information developed by Information Theory. It refers to anything that enters a system and makes a difference to its development. It is entirely independent of either the content of the message or the material context through which it is transmitted. DNA qualifies as information in this sense, but is talked about as though it unproblematically qualifies as information in the regular sense; as though it is a code with meaning (Keller 1993; Keller 1995; Griffiths 2000; Kay 2000; Keller 2000; Waldby 2001; Griffiths 2002; Ingold 2004). Interpreting the metaphor of information literally perpetuates a model of the gene as an independent repository of abstract specifications for the organism, and, by inference, a model of development as the simple unfolding of these instructions and a model of the organism as a mere conglomerate of genes, or genetically determined traits. These models uphold a form/matter distinction (Waldby 2001), with genes representing a kind of intact preformationist information, and organisms providing the mute matter through which these specifications manifest. Thus, “the genetic code was more than just a deterministic metaphor—it was ontologically impotent, the progenitor of life, and inherently unaffected by the environment” (Sidler 2006: 64).

This reductionist account of organisms and the code-centric picture of development are challenged by the developmental biologists who question the nature and extent of the gene’s role in the development of life and the ultimate phenotype of an organism (Sidler 2006; see

⁷⁸ Such metaphors can be used literally or figuratively but still have epistemological power (Sidler 2006; Petersen 2005). They deliberately invoke particular associations which ultimately direct research and development: “[r]hetoric and language have primary roles in scientific inquiry, creating and framing paradigms through knowledge-producing discourse and through a conscious employment of tropes” (Sidler 2006: 59). The genetic code metaphor has become a ubiquitous descriptor across scientific discourse, popular culture and mass media reports.

⁷⁹ Recognised as a ‘functional gene product’.

Oyama 2001). The model of organism development as a straightforward execution of the genetic program does not account for the large proportion of ‘junk’, or non-coding DNA, with no clear purpose, and cannot account for cell differentiation, given that all cells are ‘reading’ from the same genetic material. There are complex interactions between DNA and its cellular environment that make gene expression more multi-factorial and conditional than is publicly recognised. There are developmental genes, as differentiated from structural genes that ‘code’ for traits, that regulate the expression of other genes in a complex feedback system that is heavily contingent on inputs from internal and external environments. The vision of the gene as the primary actor in the development of life is misguided because it is organisms, not genes, that interact with the environment:

If genes interact with anything, it is with other constituents of the cell, which interacts with other cells in the organism, which interacts with other organisms in the world. It is out of this multi-layered process that the capacities of living beings emerge. In other words, these capacities are outcomes of the whole developmental system comprised by the presence of the organism, in its particular genetic and cellular composition, with its environment (Ingold 2004: 217).

The idea of the gene has shifted over time from the *faktors*⁸⁰ that Mendel saw as responsible in unknown ways for the predictable ratios of inherited characteristics, to an informational entity that is at the core of all life processes (Kay 2000). DNA is not, however, the only inherited material; there are other cellular structures and biochemical compounds⁸¹ that play key roles in embryonic development and that are disregarded in the ‘gene transfer’ account of reproduction and evolution. The widest form of non-genetic inheritance is contingent on the macro-activities of the organism in the world: the accumulated effect of the organisms on their environment (Griffiths 2000, 2002). The straightforward neo-Darwinian evolutionary model of a relatively stable environment that exerts a selection pressure on its resident organisms – or, in the reductionist vision, on their genetic material – to affect its evolution is under challenge from the emerging recognition of “the capacity of organisms to construct, modify, and select important components of their local environments” (Day *et al.* 2003: 80). In the ‘niche construction’ perspective of evolution, the organism also inherits an ecological home in the physical environment of animals’ nests, dens and burrows, and the

⁸⁰ Mendel’s *faktoren*, inferred from his observation of the inheritance of discrete traits, were non-material factors. They were described in material form as ‘particles’ in 1900, then as ‘genes’ in 1906. The conceptual separation of the unit of inheritance from physical traits came in the 1910s with the distinction between genotype and phenotype, though the gene was still intermittently considered a hypothetical construct. *Faktoren* were ultimately regarded as material entities of DNA molecules and their structural organisation described by Francis & Crick in 1953 (Falk 2006).

⁸¹ The egg cell contains basal bodies and microtubule organising centres, cytoplasmic chemical gradients, DNA methylation patterns, membranes and organelles, as well as DNA (Griffiths 2002).

chemical environment of the atmosphere as affected by the photosynthesis of parent plants. This tailored environment exerts a selection pressure on the organism (Day *et al.* 2003; Odling-Smee *et al.* 2003) and the niche constructing activities of the organism in its environment are implicated in its own evolution.

The conceptual shift from organism to gene as the primary unit of life through the biotechnological discourse of similarity signifies the loss of more than these broader, more nuanced explanatory devices. A reductionist picture of organisms that describes them in terms of their genes asks people to forget about other ways that animals and plants have been thought about. It effectively transforms nature from a world of differentiated, defined organisms with unique characteristics inseparable from the complex ecological relationships which secure them to their environments, to a vast genetic resource of inert, undifferentiated and manipulable matter. Contemporary wild and domesticated plant seeds are bureaucratically and practically transformed into ‘plant genetic resources’⁸² (Pistorius & van Wijk 1999; for example Allem 2000; Heslop-Harrison 2002; Quisenberry & Clement 2002), and their conservation takes place in large-scale artificial ‘gene banks’ (Plunknett & Horne 1992; Chin 1994; Bowen 1999; Stacey *et al.* 1999). Reframing the natural world in genetic terms in the context of biotechnological capacities calls attention to its inherent manipulability. While the similarity of the genetic sequence across kingdoms is publicly highlighted to ease concerns about crossing species boundaries, the “symbolic richness” of plants and animals is “seriously diminished” (Brown & Michael 2001: 283; Midgley 2000). Within a meaningful human-nature relationship, “organisms are ontologically irreducible entities” (Rehmann-Sutter 2000: 334): they constitute living nature as we encounter it in the world of appearances.

With the gene as the new ontological object of nature, the world is no longer as it appears in everyday experience, and nature is conceptually reduced in both physical size and figurative stature. An aggregate of genes is, as demonstrated in the routine granting of intellectual property rights over genetic sequences, an aggregate of resources. To the extent that this reconfiguration is a rhetorical strategy for naturalising biotechnological interventions, it fails to take the full measure of concerns about the implications of biotechnology for nature. The unnaturalness concern “reflect[s] concerns about loss of meaning entailed by a perceived fracturing of relationships” (Holland 2004; Deckers 2005) and is in essence, as is environmentalism more generally (Evernden 1992), a protest against the enframing of nature as merely a resource.

⁸² Through twin emphases on biodiversity *qua* genetic diversity as a conservation imperative (Ridder 2007) and on germplasm conservation for biotechnological purposes.

Contra the soritical logic that couples the morality of genetic engineering to the morality of domestication, “[t]o accept certain stages in a process (such as domestication) as morally acceptable does not necessarily imply that all of the later stages in the same process are also acceptable, especially when there are good reasons to believe that there are morally relevant differences in these stages” (Verhoog 1992: 158). It is well within the evolutionary vision to “only appreciate something as distinctive and novel by seeing it as the culminative stage – one that reaches a limit – of a continuous process” (Cooper 1998 in Bowring 2003: 132). Rather than there being no moral dimension to traditional domestication, the ethical significance of the domesticatory relationship has simply become more visible, meaningful and consequential in the context of biotechnology⁸³. The historical process of modifying nature to make it more amenable for human purposes is instead seen to have reached its moral limit in biotechnology:

[a]lthough [people who see genetic engineering as unnatural] are prepared to accept that we already live with considerable human intervention in the environment, particularly in the high intensity agriculture involved in modern food production, genetic modification seems like a ‘step too far’. Indeed the advent of genetic technology may have prompted some people to reflect on just how far we have come in terms of our interventions, in gradual steps, and to question these interventions from a fresh perspective (Nuffield Bioethics 1999: 96).

Agricultural biotechnology provides a vantage point from which to judge the philosophical import of all domesticatory interventions in nature. From here, the place, role and contribution of nature in domestication becomes morally relevant. The biological and botanical characteristics of the plants in question, such as reproducing sexually or maintaining a species-specific morphology, come to be retrospectively valued. These are characteristics that domesticated nature shares with wild nature and that maintain the independent existence of domesticated nature in the context of its instrumental use. The genetically engineered plant provides an object of comparison against which the conventional domesticate appears more natural, just as a plantation forest would highlight the naturalness of a neighbouring bush reserve⁸⁴. Traditionally, domesticated nature has not counted as nature proper, but, in the context of biotechnology, it comes to be positively valued *qua* nature. It also becomes an object of interest for the field of environmental ethics.

⁸³ Sandoe *et al.* (1996) make this same point specifically with regard to the introduction of biotechnological methods into animal domestication.

⁸⁴ Equally, biotechnology has come to appear relatively natural next to more recent innovations such as synthetic biology (see Preston 2008).

In a study that codifies the genetic engineering debate according to the underlying ethical principles of its constitutive arguments, Cooley *et al.* (2004) interpret the unnaturalness objection as an affirmation of conceptualisations of value in nature already established in environmental ethics. They attribute the consumer preference for natural over unnatural to the principle of the *intrinsic value of nature*. The sentiment that it is morally wrong to either own or alter the elementary parts of nature, including genetic material, is traced to the principle of *respect for the autonomy of nature*, while the green imperative to protect wild areas from chemical and genetic pollution is traced to the principle that humans have a *stewardship duty*⁸⁵ to ensure the flourishing of nature⁸⁶. The relevance of environmental ethics principles to the protection of domesticated nature *qua* nature is also affirmed by an amendment to the Swiss Constitution in response to unnaturalness objections that supports and protect the ‘dignity of creatures’, which is interpreted to be synonymous with the intrinsic value of nature as theorised in environmental ethics literature (Balzer *et al.* 2000).

Christopher Preston (2005) presents an argument for an environmental ethics approach to philosophical questions about nanotechnology, which establishes the relevance of the field on both practical and theoretical grounds. Similarly, the capacity for environmental ethics to provide an understanding of the moral dimensions of domestication and biotechnology is theoretically-based, in that the field provides analysis and guidance for the moral relationship of human beings to the environment. The recasting of domesticated nature as nature places it firmly within this scope. It is also practically-motivated, in that public perceptions and articulations of the impact of biotechnology on nature are implicating environmental ethics theories of value into the inquiry.

Conclusion

Appraisals of the claim that genetic engineering is unnatural consistently identify two main problems. One relates to the logical flaw of conflating naturalness with goodness and unnaturalness with inimicality. The unnaturalness objection can be disregarded if it is taken as an instance of the naturalistic fallacy. It is able to avoid this categorisation, however, because the phrase ‘genetic engineering is unnatural’ is a simplified version of a series of complicated concerns and its proliferation is in part an effect of the methodology of

⁸⁵ Stewardship duty was also identified as a key environmental theme of Canadian biotechnology debates (Capelli & Saner 2003).

⁸⁶ According to the authors of the study, the first two principles are intrinsically biased toward opposition to the technology, while the third is relatively neutral and is used by both sides. The notion of stewardship traditionally relates to the protection of nature in wilderness areas and there is little argument about whether or not the wild environment should be protected. What is at issue is whether biotechnology is the best method to achieve this.

capturing public concerns *via* closed question surveys, and of the problems associated with persistent definitional uncertainty about 'nature' and 'naturalness' as descriptive and normative terms. The second problem relates specifically to the natural/unnatural dualism and the difficulty of definitively assigning domesticated nature to one category or the other. Domesticated nature has been extensively modified by humans over time and prominent natural/unnatural binaries do not offer an easy way to distinguish it from genetically engineered nature. Given this ambiguity, the concept of unnaturalness tends to be interpreted in a broad sense as a negative departure from some originary state, and the unnaturalness objection assessed against whether the introduction of genetic engineering into plant breeding constitutes an evolutionary step or a revolutionary leap.

Proving continuity between pre- and post- biotechnological domestication is the name of the game in the creation of positive representations of genetic engineering. The popular adoption of the term 'genetic modification' emphasises similarity and distracts attention away from difference. Pro-biotechnology writings answer the charge of unnaturalness with historical accounts of domestication that frame the emergence of genetic engineering as the natural evolution of previous methods, while preserving its revolutionary aspect by similarly situating it within a long line of positively valued innovations. These accounts tend to give the complexities and discontinuities of the 10 thousand year old people-plant domesticatory relationship only cursory attention. Much of the continuity identified between biotechnology, domestication and evolution rests on a teleological interpretation of chronological events and semantic twists that recast natural history in genetic terms. Taken together, these narratives present a normative picture of nature as a resource, and domestication as a rightly instrumental relationship between humans and nature. This secures precedence for the intent and purpose, if not the methods, of modern biotechnology.

Through a discourse of similarity, genetic engineering and domestication come to share the same moral implications. An argument against genetic engineering must also find against previous practices of domestication, just as prior public acceptance of conventional domestication is taken as a mandate for modern biotechnology. There is, however, another moral possibility contained within the evolutionary/revolutionary tension. Traditional and conventional domestication need not have breached a moral limit in order to have a moral dimension. Unnaturalness objections are not necessarily a fallacious appeal to nature to bolster the authority of marginal consumer objections, but stand as an affirmation of the natural value of domesticated nature, a protest for its protection and an assertion of its ongoing moral significance and moral considerability.

The field of environmental ethics is well placed to offer interpretations, justifications, or, in the least, analyses of philosophical concerns about biotechnology, and has made some

significant contributions to the debate in this regard. However, its theories of value in nature have been developed primarily to account for the value of wild nature and in the context of providing sound philosophical reasons to ensure wilderness conservation. The recasting of domesticated plants as natural effectively extends the nature that environmental ethics theorises and seeks to protect, and presents a challenge to the established perimeters of the field. The conceptual capacity of environmental ethics to provide an informative account of the moral dimensions of people-plant domesticatory relationship – in particular, to reconcile the recognition of natural value in domesticated nature with its ongoing modification and use – is taken up in the following two chapters.

Chapter Three

Environmental ethics on domestication: the place and status of domesticated nature

Introduction

This chapter reviews the traditional place of domesticated plants in the main streams of environmental ethics scholarship. Consistent with other critical reviews of the field, it identifies a bias in favour of wild nature to the neglect of nature with which humans have considerable interaction. This bias is traceable to the original imperative for environmental ethics to provide philosophical grounds for the preservation of wild places, and has been consolidated by the development of value theories suited to this task. Non-anthropocentric axiologies that assume a model of nature as an independent and ecologically intact wilderness are not easily applicable to other landscapes and tend to produce a strong ethical discontinuity at the boundary between wild and domesticated nature.

This chapter assesses the place of domesticated nature in four exemplar versions of intrinsic value theory: Paul Taylor's biocentric egalitarianism; Holmes Rolston III's holism and duties to species; J.B. Callicott's ecocentric interpretation of the land ethic; and Eric Katz's value distinction between a biological artefact and a natural object. These approaches are at best partially applicable to domesticated nature, and at worst explicitly hostile toward it. As exotic invaders, domesticates pose a risk to the ecosystemic integrity of wild nature. As organisms that are ontologically and developmentally dependent on humans, they threaten the replacement of real nature with biological artefacts. Domesticated nature would be incidentally included in accounts of intrinsic value at the scalar level of the organism and the species to the limited extent that resembles wild nature, but is specifically excluded by addendum. For the most part, domesticated nature is regarded as having been subject to human interference to the degree that it no longer qualifies as natural.

Underlying these conceptualisations is a particular understanding of domestication as a culturally-driven process of human domination over nature, which is at the core of the contemporary physical and conceptual separation between humans and nature. This domination also exemplifies the instrumental attitude to nature that is so strongly rejected by intrinsic value adherents. Domestication necessarily entails the instrumental use of nature;

thus it is subject to the pre-existing and well-recognised problem of reconciling the moral obligations of intrinsic value theory with the use and modification of nature. The broad proscription of interference that has traditionally accompanied the recognition of nature's intrinsic value is not practicable in the case of domesticated nature. Domesticates must be denied intrinsic value simply so that agriculture can continue and life can remain liveable.

The exclusion of domesticated nature from moral consideration is problematic on a number of fronts. In contemporary biotechnology debates, popular protests on behalf of domesticated nature have mobilised environmental ethics accounts of natural value and identified a moral dimension to domestication with respect to the naturalness of domesticated plants and animals. Environmental ethics is best placed to elucidate the basis of this protest, yet the unsuitability of its key conceptual resources to a positive view of necessary human activities that modify nature, and thus a positive place for humans in the natural world, constitutes a significant limitation of the field. The low status of less-than-wild nature generates a value split along wild/domesticated lines that maintains a dualistic conception of nature which must be overcome in order for environmental ethics to remain instructive in the biotechnological and post-biotechnological era.

The primacy of wild nature

Since its inception in the early 1970s, the task of environmental philosophy, or more specifically environmental ethics⁸⁷, has been the articulation of sound reasons for protecting wild places from destructive and polluting activities, beyond strictly human determinations of the value of such places. A founding concern about wild nature is customary across the field: deep ecology was founded on the mountaineering wilderness experiences of Arne Naess (1973, 1984, 1989); concern for the protection of the remaining North American wilderness informed the 'wild' philosophy of Holmes Rolston III's (1986) objective intrinsic value in nature; while Aldo Leopold's (1949) earlier diagnosis of environmental problems as philosophical in nature⁸⁸, and his development of the land ethic, was born of an immersion in wildlife and forestry. With attention to the independent value of the individual organic inhabitants of wild areas, the species to which these individuals belong, and the larger ecosystems of which they are a part, nature *qua* wild nature has been the traditional focus of environmental ethics.

⁸⁷ The field of environmental ethics is just one branch of environmental philosophy, but in practice its priorities have dominated the discipline to the extent that 'environmental philosophy' and 'environmental ethics' are often used synonymously (Foltz & Frodeman 2004).

⁸⁸ This link between ethical attitudes toward the environment and environmental problems is foundational to environmental ethics (Dickson 2000).

This focus is neither surprising nor unwarranted. High profile exposure of the effects of industrial pollution and extractive industries on ecological systems in the 1960s and early 1970s played a significant role in the origins of the modern environment movement and the field of environmental philosophy. Scientific warnings about environmental impacts, ‘silent springs’ and population explosions motivated protest and legislation for the containment of pollution and the protection of wild places. The response from philosophical quarters to build ‘a new, an environmental ethic’ that could support the protection of wild nature and account for its otherwise philosophically unproblematic destruction came officially in 1973⁸⁹, and the new discipline’s principal journal *Environmental Ethics* began publication in 1979. Environmental ethics developed “largely as an intellectual response to what is perceived to be an environmental crisis” (Dobson 1997: 211), and the identification of wild nature as the environment in question is consistent with the green priorities of the era. The terms of debate for the field were strongly informed by the political imperative to save wild places⁹⁰. Importantly, the ecological scientific descriptions of wild places that were so central to this imperative also provided environmental ethics with a ‘ready-made ontology’ of nature – nature without humans (Foltz & Frodeman 2004: 4).

The original aim of providing a philosophical basis for the defence of wilderness has also significantly affected the kinds of theories of value that were pursued. An ethic that will do the work of protecting areas of wild nature from despoliation or destruction is one that places a moral obligation on humans to leave such areas alone. The classic philosophical distinction between intrinsic value and instrumental value was a key area of scholarly interest throughout the 1980s. The task was to establish that nature has intrinsic value beyond the instrumental value it has for humans. Natural entities and systems were argued to not only be valuable to the extent that they can be used to fulfil human and human-oriented ends but to also have their own ends. An old-growth forest, for instance, is not merely instrumentally valuable for the purposes of scientific research, for ecosystem services such as keeping the air and water ways clean, for recreation, or for natural resources such as timber. A forest has a ‘good’ of its own that is independent of the use that humans make of it. Proponents of the intrinsic value of nature differ on the issue of what level of organisation in nature is morally considerable. Depending on the proposed locus of value, the forest is intrinsically valuable because its inhabitants, their species, or the whole

⁸⁹ Officially in the form of Richard Routley’s paper, *Is there a need for a new, an environmental ethic?*, presented at the 15th World Congress of Philosophy. Arne Naess’ article, *The shallow and the deep, long-range ecology movement: a summary*, published in 1973, just pre-dated Routley’s piece.

⁹⁰ This imperative also contributed to the dominance of ethics over the larger discipline of environmental philosophy. Where key controversies have centred on philosophical issues, they have related to the capacity of these issues to assist in building a persuasive ethical model. The field has not primarily set out to describe an ontological but an axiological account of the non-human world (Foltz & Frodeman 2004).

ecosystem is good as an end in itself. Further, intrinsic value has a morally obligating character that directs humans to show respect to living entities in ways that address, and are affirmative of, the intrinsic value of the organism. The destruction or despoliation of the forest is deemed morally wrong. Recognising the intrinsic value of nature thus rules out a range of human interferences in these areas – from extractive works, to hunting, to camping activities that damage surrounding vegetation.

Traditionally, only humans were considered to possess intrinsic value. Kant (1785 [1950]) reasoned that humans had intrinsic value because their rationality gave them the ability to value themselves inherently, and to recognise that others do the same. Recognition of humanity's intrinsic value entailed the moral obligation that human beings are not to be treated exclusively as a means to another's end but are always also to be treated as ends-in-themselves. On this basis, slavery is deemed immoral because it treats human beings solely as a means to another's ends. More recently, intrinsic value was recognised to be held by animals. Animal rights literature presents two ideotypes of the equal moral standing of all sentient animals: their shared capacity to suffer⁹¹ (Singer 1975) and their shared capacity to consciously lead their lives (Regan 1983), with the former position being more widely recognised than the latter. In Singer's utilitarian schema, the locus of intrinsic value is the experience of pleasure, while Regan's ethical vegetarianism recognises the intrinsic value of an animal's experience of being a 'subject-of-a-life'⁹². Both the capacity to feel pain and to have meaningful awareness of a life lived are qualities that animals have in common with humans. They are, however, qualities that are limited to sentient animals. The extension of moral consideration from humans to sentient animals but no further is why animal rights literature has been seen to be conceptually distinct from environmental ethics, and having no contribution to make to a comprehensive environmental ethic⁹³. Animal rights literature has nothing to say about the non-animal elements of nature – plants, species, ecosystems, micro-

⁹¹ This criterion is adopted from eighteenth century utilitarian philosopher Jeremy Bentham's (1789 [1948]) reference to animal welfare using the greatest happiness principle: 'The question is not can they reason? nor can they talk? but can they suffer?'

⁹² On this logic, Singer would not be concerned about rocks and other inanimate nature because they don't suffer, where Regan would not worry about them because it is impossible to conceive of what their good might be (Johnson 1984).

⁹³ It is through these discussions about the ontological and moral status of domesticated animals that most attention has been given to moral dimensions of domestication in environmental ethics. The familiar discord between environmental ethics and animal welfare concerns about the invisibility of animal suffering under intensive husbandry is traced to their "profoundly different cosmic vision[s]" (Callicott 1980: 315). The seeming impossibility of reconciling broad ecological with individual animal interests has ostensibly excluded animal rights literature from contribution to an 'environmental ethic proper' (see Jamieson 1998; Callicott 1980 [*cf* Callicott 1988]; Sagoff 1984; Palmer 1995). The status of domesticated animals within environmental ethics as disclosed through this debate is still informative. There are limitations to its applicability outside specific discussions about the nature of animal welfare and our moral obligations to sentient beings, but the treatment of domesticated animals provides at least a starting point for understanding the established place of domesticated plants in environmental ethics.

organisms or non-organic natural entities like rocks and rivers, and what it has to say about animals is hard to reconcile with wilderness concerns. In deriving value from what is shared with humans, the ethic proposed by animal rights literature, though a zoocentric ethic, or strictly speaking a pathocentric ethic⁹⁴, remains human-centred, or anthropocentric. In this context, it is not surprising that the animals under consideration are those closest to human beings; animals that have been domesticated for laboratory science and for food.

The difference between the domesticated focus of animal rights literature and the wild focus of environmental ethics is near impossible to reconcile. For environmental ethics, the extent of the genetic, phenotypic and environmental modifications experienced by animals under domestication means that they may no longer be natural entities, but human creations: “[d]omestic animals are creations of man. They are living artefacts, but artefacts nevertheless ... It is literally meaningless to suggest that they be liberated” (Callicott 1980: 330). On this basis, any opposition to factory farming by environmental ethicists relates only to its “unsustainability and its polluting effect on the nature outside, but not because of the things done to the natural beings inside” (Noske 2004: 6). On the question of animal suffering, environmental ethics values the wild state of the animal over welfare concerns. Our duty to domesticated animals is only that they should experience “no more suffering than would have been their lot in the wild” (Rolston 1998: 79). While Singer’s and Regan’s zoocentric ethics would compel us to alleviate animal suffering wherever it was found, within environmental ethics the main ethical responsibility that people have towards animals is not to interfere with them in the wild (Palmer 1995).

The rejection of anthropocentrism

The primacy of wild nature in environmental ethics is clearly central to the animal rights dispute, but equally so is the distinct human-centredness of animal rights axiology. Animals are argued to be valuable because they have some very particular qualities that they share with humans, not because they are autonomous entities with goals, capacities and strivings of their own, nor because they are significantly ecologically embedded⁹⁵. The moral extensionism of zoocentric ethics does not require any radical revision of traditional ethical theories of value; it merely broadens the moral consideration that is afforded humans to

⁹⁴ Warwick Fox (2006) differentiates zoocentric from pathocentric because animal welfare literature is more accurately concerned with suffering than animality. This noted, the more commonly used ‘zoocentric’ will be retained for the purposes of this paper.

⁹⁵ Indeed, animal rights literature is critiqued for portraying animals as though they were “isolated, city-dwelling consumer-citizens, living entirely outside of any ecological context” (Noske 2004: 4) rather than explicitly natural entities.

include all sentient animals. On the other hand, environmental ethics rejection of human-centred approaches to value in the natural world is key to its novelty as an ethical system. The original project of environmental philosophy was to construct a new ethical system that eschewed the philosophical orientation that had allowed the ecological crisis to come to pass. Historian Lynn White's much-cited 1967 paper that identified Christian notions of mastery of humans over the natural world as the basis for ecologically destructive cultural practices was an influential foundation piece in this regard. The rejection of anthropocentric theories of value, which were understood as the root cause of environmental crisis, was the basis of the search for theories of independent value in beings and groups of beings other than humans.

Given this context, it is difficult to disentangle the causality of the axiological focus on intrinsic value and the geographical bias for wilderness areas. The political focus on wild nature established intrinsic value as the principal theory of value⁹⁶ (notwithstanding the equally influential deep ecology approach to environmental philosophy), just as the strong rejection of anthropocentric ethics initiated the pursuit of intrinsic value theory, which in turn determined the landscapes to which environmental ethicists turned their attention. The autonomous, non-human, non-cultural value of nature – nature as it exists in complete independence of human valuations directed by cultural preferences and the pursuit of economic gains – is more easily observable in areas where there is little human influence. So-called 'pristine nature' such as wilderness is thus an exemplar site for intrinsic value:

If nature is to be considered as valuable in itself then, however the ground of that value is metaphysically or ontologically conceived, it will best be identified in those areas relatively independent of human intervention as opposed to those humanly shaped areas which exemplify exactly those culturally bound preferences that many environmental ethicists wish to reject (Light 2001: 12).

An ontology of nature *qua* wild nature is also central to deep ecology approaches to environmental philosophy. Deep ecology, while it assumes that nature has intrinsic value, is not concerned with proving this assertion, but is non-axiological in its conceptualisation of living well in nature. It offers a non-anthropocentric⁹⁷, ecological description of the strongly imbricated relationship between nature and humans. This interconnection is both material and spiritual, and ultimately reconfigures human self-interest to include the interests of nature, so that ecological awareness, experience and activism are considered essential aspects of individual human self-realisation (Naess 1989; Fox 1991; Katz *et al.* 2000). Deep

⁹⁶ With some key exceptions (see for instance Norton 1984; Passmore 1974).

⁹⁷ Though has been described as anthropocentric at core in that it derives nature's from human interests (Grey 1993; Katz *et al.* 2000).

ecology is only concerned with domesticated nature with respect to the ecological obligation to ensure that it does not encroach into 'free' nature. A central tenet of deep ecology is that "[h]umans have no right to interfere destructively with non-human life except for the purposes of satisfying vital needs"⁹⁸ (Naess 1984: 266). Proposed methods of reducing the destructive impact of satisfying vital needs and containing the spread of agricultural lands, such as through the development of local, bioregional agricultures, tend to rely on a concomitant reduction in human populations⁹⁹.

Of the environmental ethics approaches that are distinctly axiological – virtue ethics that directs moral obligations according to particular accounts of human excellence in relation to nature; utilitarianism equations that determine the greatest good according to the consequences of certain environmental actions; and deontological directives that prescribe in-principle wrongs that can be done to nature and tend to rest on accounts of its intrinsic value – non-anthropocentric intrinsic value theory has been the mainstay for much of the early development of the field. Though in the minority, anthropocentric theorists have made significant contributions; indeed, the dispute between anthropocentrism and non-anthropocentrism has been a defining feature of the field. Vocal advocates of anthropocentrism have argued that there is no need for a radical transformation of our ethics in order to live well with nature, as there are good enough reasons to protect nature within a qualified anthropocentric approach (see Norton 1984; Weston 1985; Grey 1998). They argue that establishing the intrinsic value of nature is a philosophically difficult, if not impossible, task, and an unnecessary one. If the concept of humanity is sufficiently enriched by the acknowledgement of our part in larger ecological systems,

an anthropocentric concern for our own well-being naturally flows on to concern for the nonhuman world. If we value ourselves and our projects, and part of us is constituted by the natural world, then these evaluations will be transmitted to the world (Grey 1993: 466).

⁹⁸ This is the third of the eight principles of the deep ecology platform developed by Naess and Sessions in 1984: "1) The well-being and flourishing of human and nonhuman life on Earth have value in themselves... These values are independent of the usefulness of the nonhuman world for human purposes. 2) Richness and diversity of life forms contribute to the realization of these values and are also values in themselves. 3) Humans have no right to reduce this richness and diversity except to satisfy vital needs. 4) The flourishing of human life and cultures is compatible with a substantial decrease of the human population. The flourishing of nonhuman life requires such a decrease. 5) Present human interference with nonhuman world is excessive, and the situation is rapidly worsening. 6) Policies must therefore be changed. The changes in policies affect basic economic, technological, and ideological structures. The resulting state of affairs will be deeply different from the present. 7) The ideological change is mainly that of appreciating life quality (dwelling in situations of inherent worth) rather than adhering to an increasingly higher standard of living. There will be a profound awareness of the difference between big and great. 8) Those who subscribe to the foregoing points have an obligation directly or indirectly to participate in the attempt to implement the necessary changes" (in Devall 2001 [1988]).

However, proponents of intrinsic value reject anthropocentrism because they believe it is unable to inform an authentic ecological consciousness. It is regarded as the cause of environmental problems and, not insignificantly, its rejection is the reasoning for the establishment of the field itself. Even where it is conceded that an anthropocentric ethic might lead to the same outcome as a non-anthropocentric one¹⁰⁰, for instance, where scientific utility would lead to the protection of wilderness areas, it is important to non-anthropocentrists that the right thing is done for the right reasons (Callicott 1995; McShane 2007). Nature must be preserved for what it is in itself, not what it can do for us.

The non-anthropocentric perspective has tended to regard anthropocentric approaches as advocating an instrumental relationship with nature (Light 2001). Instrumentalism “goes beyond a mere account of nature as being instrumentally valuable toward humans” (Lee 1993: 334). Narrow instrumental valuations of nature – ‘the despotic view’ according to Sylvan (1973)¹⁰¹ – also allows for the unproblematic destruction of wild areas for the sake of human enterprise. When nature is only valuable for what it can produce for human consumption, enterprise or recreation, there appears to be no moral barrier to its destruction to meet those human-directed ends. While the purely instrumental view is clearly anthropocentric, it does not necessarily follow that all anthropocentric views are excessively instrumental, even though they may be speciesist. However, “the view that anthropocentrism is wedded to a crude instrumentalism persists in some forms to this day even while the reliance on intrinsic value is waning” (Light 2001: 11).

While intrinsic value theory has its discontents, and its popularity has diminished in recent times, establishing the intrinsic value of independent, wild, natural entities and systems has been a primary axiological task of environmental ethics. The non-anthropocentric foundations of the field and its search for intrinsic value in nature underlie its neglect of the built environment within environmental ethics (Fox 2000; Light 2001), and the devalued place of domesticated food plants has been similarly determined by these tendencies. The following section presents an analysis of the implied, explicit or prospective place and status of domesticated nature in four exemplars of non-anthropocentric intrinsic value¹⁰². The first is Paul Taylor’s biocentric egalitarianism, which offers a clear explication of the intrinsic

⁹⁹ Indeed, the fourth of Naess’ eight principles of deep ecology is that: “[t]he flourishing of human life and cultures is compatible with a substantial decrease of the human population. The flourishing of nonhuman life requires such a decrease” (in Devall 2001 [1988]).

¹⁰⁰ As argued in Brian Norton’s (1991) ‘convergence hypothesis’.

¹⁰¹ This view, also termed ‘human chauvinism’, is more extensively detailed in Routley and Routley (1979).

¹⁰² An analysis of deep ecology is not included in this section, as the cosmology of deep ecology is overtly concerned with wild nature, and the schema of intrinsic value theory lends itself more readily to criterion-based assessment.

value of individual living organisms. The second is Holmes Rolston III's writings on the moral considerability of species, and the third is J. Baird Callicott's argument for ecosystemic value through his holistic communitarian interpretation of Aldo Leopold's land ethic. These three versions of intrinsic value apprehend domesticated plants at a different scalar level. The fourth is concerned with the intrinsic value of nature's independence from human interference, exemplified in Eric Katz's value distinction between natural objects and artefacts.

Domesticated plants and the intrinsic value of individual organisms

Wild nature is 'wild' because it is able to live, thrive and reproduce independent of human involvement. Agricultural and horticultural food plants are 'domesticated' because they lack ecological autonomy, and are highly dependent on human activity for their very survival. There are no particular taxonomic differences between domesticated food plants and their wild counterparts; the Linnean system applies to wild and domesticated species equally and makes no special case for domesticates¹⁰³. Although "[t]he label 'domestic' identifies no natural kind, and is dispensable from the taxonomists point of view" (Brennan 1984: 46), domesticates do, of course, differ from wild plants in specific ways. More of their photo-assimilated energy and soil-sourced nutrients are directed toward their food bearing parts, whether these are stems, roots, leaves, seeds, flowers or fruits. The enlargement of these select parts is the result of the process of domestication: artificial selection by humans over time for food-bearing plants that offer higher – and sweeter – yields of their edible parts, making them more economical to cultivate and more efficient to process and eat. Changes to the plant's shape and form are morphological, changes to its taste are biochemical, but the accompanying changes to its reproductive functions are ecological. Domesticated plants have evolved poor seed dispersal mechanisms that make them easy to harvest and dependent on farming activities for their reproduction. In some cases, such as corn (*Zea maize*) which is unable to disperse its seeds at all, this dependence is total, though in others, such as canola (*Brassica napus*) that can still scatter its seeds in the field, it is only partial. The biophysical differences between wild and domesticated food plants – loosely summarised as a 'domestication syndrome' in which domesticated plants have larger, sweeter food-bearing parts, uniform ripening times, and reduced ecological functions than their wild counterparts and ancestors – are the basis of domesticates' suitability for cultivation in food production systems. Domesticates have been progressively transformed by human selection activities

¹⁰³ Although at the time of developing his taxonomic system, Linnaeus proposed that some domesticated varieties, such as lettuce and leek, were separate species from their wild forms (Van Raamsdonk 1993).

but still remain biological entities with their own internal, goal-directed workings. And it is this characteristic, common to all living things, that is recognised by the biocentric strand of non-anthropocentric intrinsic value theory as giving its possessor intrinsic value.

The recognition of intrinsic value in all living things was foreshadowed in Albert Schweitzer's (1923 [1987]) 'reverence for life', outlined in Kenneth Goodpaster's (1978) identification of the interests of nonsentient beings, and the basis of Paul Taylor's (1984, 1986) biocentric egalitarianism. In Schweitzer's view, every living organism is worthy of our respect because it has a 'will-to-live', although his recognition of this more closely resembled religious revelation than reasoned argument (Myskja 2003). Goodpaster (1978: 310) rejected the primacy of sentience in determining the moral considerability of organisms, arguing that "[n]othing short of *being alive* seems to be a plausible and nonarbitrary criterion"¹⁰⁴. Taylor's 'respect for life' thesis recognises intrinsic value in living individual organisms on the basis that they are all goal-directed beings that have a good of their own. Trees are not mere objects but living entities that strive for sunlight, seek out water and nutrients, and protect themselves from predation¹⁰⁵. The flourishing of their living bodies as they reach their goals constitutes their 'good', which is either able to be encouraged or hindered by human activity. Each individual living thing in nature – whether animal, plant, or micro-organism – is a 'teleological centre of life', irrespective of whether it possesses sentience. All individuals that are teleological centres of life have a good or well-being of their own which can be enhanced or damaged. This entitles them to moral respect by granting them equal intrinsic value, or what Taylor calls 'inherent worth'¹⁰⁶.

Inherent worth is the value something has simply in virtue of the fact that it has a good of its own. To say that an entity has inherent worth is to say that its good (welfare, well-being) is deserving of concern and consideration of all moral agents and that the realization of that good is something to be promoted or protected as an end in itself and for the sake of the being whose end it is (Taylor 1984: 151).

¹⁰⁴ Goodpaster is critical of Joel Feinberg's (1974) rejection of the idea that non-sentient living beings can have a good of their own in any meaningful sense. Feinberg argues that only sentient beings with wants, needs and desires can be said to have a good that we are morally obliged to protect. Trees do not have their own sakes, "despite the fact that they have biological propensities. Having no conscious wants or goals of their own, trees cannot know satisfaction or frustration, pleasure or pain. Hence, there is no possibility of kind or cruel treatment of trees" (p. 52). The good of plants and their goal-directed need for sunshine and water is analogous with the good of a car and its need for oil and petrol. It is 'no tragedy' for cars to be without fuel because they are only given their functions by humans and, according to Feinberg, so are plants: "Plants may need things in order to discharge their functions, but their functions are assigned by human interests, not their own" (p. 54).

¹⁰⁵ Agar (2001: 100) refers to such goals as the 'biopreferences' of the organism, but suggests that domesticated organisms are "teleologically subservient to human goals".

¹⁰⁶ Although Taylor made a distinction between inherent and intrinsic worth, this differentiation has not been widely adopted and the term 'intrinsic value', though not unproblematic in itself, is considered sufficient a term.

If merely having and striving for a life-directed goal is the basis for intrinsic value, domesticated organisms are “exactly like wild animals and plants in natural ecosystems” (Taylor 1986:55) and would seem to be unproblematically included in an egalitarian biocentric ethic. Indeed, more recent environmental ethics responses to genetic engineering in agriculture have employed a qualified version of Taylor’s biocentrism to demonstrate the moral considerability of domesticates in the face of biotechnological interventions (Balzer *et al.* 2000). In Taylor’s formulation, however, domesticates – referred to as belonging to the ‘bioculture’ – are the only exception to the ‘respect for life’ rule. It is not that the organisms themselves have less intrinsic value, but that the relationship of domestication is necessarily one of instrumental use and this is incompatible with the recognition of intrinsic value. A biocentric environmental ethic creates a moral obligation to organisms to ‘respect their wild freedom’. This approach is automatically precluded by the relationship of domestication, which Taylor presents as a relationship of domination:

When we humans create the bioculture and engage in its practices we enter upon a special relationship with animals and plants. We hold them completely within our power. They must serve us or be destroyed. For some practices their being killed by us is the very thing necessary to further our ends (1986: 55).

In a dedicated discussion of bioculture, Taylor argues that it must be excluded from an environmental ethic, echoing Regan’s (1981) early emphasis on the distinction to be made between ‘an ethic of the environment’ and ‘an ethic for the use of the environment’. Taylor concedes that there is a need for ethical consideration of the bioculture, particularly in relation to the proper treatment of domesticated animals, but clearly differentiates this from an environmental ethic. He identifies two defining features of biocultural practices that necessitate this exclusion: “[f]irst, they all depend on total human dominance over nonhuman living things and their environment. Second, they all involve treating nonhuman living things as means to human ends” (1986: 54-55). Given the strong link between domination and instrumental use, these features appear to be two sides of the same coin. However, they do not actually explain why domesticated nature in particular must be excluded from environmental ethics. A similar statement could be made about clear-felling forestry practices in wild areas, or widespread bioprospecting for medicinal plants. Given that the intention of environmental ethics is to change this relationship of dominance and the instrumental treatment of living things, to exempt certain practices from consideration on the grounds that they are already undertaken instrumentally seems to run counter to this project. However, it does illustrate the point that anthropocentrism is too often conflated

with instrumentalism¹⁰⁷, with no distinction made between respectful, moderate and excessive instrumental uses. While domesticated plants and animals would be intrinsically valuable under Taylor's 'teleological centre of life' criterion, the practical implications of intrinsic value, namely, to maintain a respectful distance from nature, are impossible to enact in the domesticated setting. Domesticates are excluded from consideration on the basis that our relationship to them *must* be different from our relationship to wild nature.

Other than Taylor's express description and exclusion of the bioculture, there is nothing in biocentric egalitarianism that should exclude domesticated nature or any life form. Indeed, the impracticality of the over-inclusiveness of Taylor's approach has been a persistent criticism¹⁰⁸. It is not surprising then that the 'teleological centre of life' thesis has been employed to support the intrinsic value, or 'integrity', of domesticates within the philosophy of organic agriculture (Lammerts van Bueren & Struik 2005) and – with some qualification – as the basis for regulatory limitations to biotechnology (Balzer *et al.* 2000). Inasmuch as domesticated plants are alive, they can be seen to qualify for moral consideration in an individualist biocentric approach, even though, as acknowledged by Taylor, the moral implications of this appear unfeasible.

Domesticated plants and the intrinsic value of species

Prominent environmental ethicist Holmes Rolston III (1999a: 39) also acknowledges the intrinsic value of an individual organism as a "spontaneous, self-maintaining system, sustaining and reproducing itself, executing its program, making a way through the world", but, where Taylor's biocentrism is individualistic, Rolston's is expressly holistic (1986, 1988, 1999a). Rolston is one of few environmental ethicists who attribute moral weight to the species to which individual organisms belong¹⁰⁹. In his systemic schema, the continuation of the species is deemed more important than the continuation of an individual organism's life, and the value of the individual organism is subservient to the value of their species.

¹⁰⁷ By way of example: "An anthropocentric value theory (or axiology), by common consensus, confers intrinsic value on human beings and regards all other things, including other forms of life, as being only instrumentally valuable, that is, valuable only to the extent that they are means or instruments which may serve human beings. A non-anthropocentric value theory (or axiology), on the other hand, would confer intrinsic value on some non-human beings" (Callicott 1984: 299).

¹⁰⁸ Simply, it "is just too pervasive and too indiscriminate a characteristic to provide a plausible foundation for moral considerability" (Grey 1993: 471).

¹⁰⁹ Biocentric approaches tend to base the protection of ecological 'wholes' on the utility that this would have for individuals. For example, Agar (2001: 145) argues that "[w]e should preserve species and ecosystems because in preserving them we best meet morality's requirement to respect or maximise the satisfaction of individual biopreferences".

A species is not an entity so much as an identity, although it has been argued that, as ‘concrete, particular and persisting’ objects, species are individuals as much as are organisms (Johnson 1983, 1991). Species are a collective characteristic of a group; they do not strive for continuation other than through the actions of their individual instantiations. They are also reproduced through the individual in the same way that the individual is reproduced through the embryo or the egg. While the certainty of the biological species concept has recently come under scientific scrutiny in light of biotechnological and genomic advancements (Rundle *et al.* 2003), for Rolston the concept remains commonsensical and durable: species exist and are real in the world.

According to Rolston, our moral obligations to individual organisms are actually obligations to their species. Interfering with an individual is tantamount to interfering with the species as it is the bearer of the species-being. In Rolston’s (2006: 5) formulation “[t]he species line is the vital living system, the whole, of which individual organisms are the essential parts. The species defends a particular form of life, pursuing a pathway through the world, resisting death (extinction), by regeneration maintaining a normative identity over time”. There is nothing in this notion of species as the locus of intrinsic value that excludes domesticated species in-principle. Domesticated species are also instantiated in individuals who strive to grow, flourish and reproduce. They represent only 0.1 percent of the world’s 250,000 flowering plant species, but over 250 species¹¹⁰ have been through the process of domestication and hold a legitimate place in the obligatory hierarchy of kingdom, phylum, class, order, family, genus and – finally – species. It is very rare for natural speciation to occur under domestication as domesticated plants become geographically and reproductively isolated from one another¹¹¹ (Van Raamsdonk 1993), so the identity of domesticated species remains largely as it emerged under natural evolution. The only clues that these species would be less valuable than wild species comes from occasional commentary from Rolston, such as his identification of domesticated animals as “inhabitants of the peripheral rural world” (1988: 79) rather than a part of nature proper; his favourable quotation of John Muir’s (1894) comments on the differences between wild sheep (“elegant and graceful as a deer, every movement manifesting admirable strength and character”) and domesticated sheep (“expressionless, like dull bundles of something only half alive”) (2002: 9); his dedicated writings (1999a) that defend the genetic makeup of organisms as the locus of intrinsic value with reference to their evolutionary development through natural and not

¹¹⁰ Of these, only 30, or 0.01% of all angiosperms, are the staples that supply most of human nutrition needs, and just three crops – wheat, rice and maize – account for 50% of the world’s calorie intake (Heywood 1999; Fowler & Mooney 1990; Hammer 2003).

¹¹¹ Two exceptions are the hybridised common wheat (*Triticum aestivum*) and spelt wheat (*Triticum spelta*) which evolved through the domestication process (Damania 1997; Van Raamsdonk 1993).

artificial selection; and his later comments on biotechnology (2002) that pejoratively describe domesticated nature as ‘degraded’ because of its reduced capacity to survive without human intervention¹¹².

Other authors who have regarded species as morally considerable have been explicit in excluding domesticated species from moral concern¹¹³. Robert Colwell (1989: 20), writing as a biologist, argues that the main basis for the intrinsic value of wild species is their essential irreplaceability: “biologists value species, in themselves, more than any individual organism within a species for the simple reason that the loss of a species means the loss not only of every living member of that species but of every future member as well”. Presumably this criterion holds for the domesticated relatives of species as well, particularly as extinction threatens older agricultural varieties as they are replaced by newer, high yielding cultivars. Colwell does advocate the conservation of domesticated species and their wild relatives, but the irreplaceability of these species is felt in terms of the need for genetic diversity to ensure the ongoing viability of human food supply, not in relation to their intrinsic value. Millennia ago, argues Colwell, the natural world diverged into wild and domestic, and domesticates have since had an ‘unnatural history’. Accordingly, “the role of domesticated species as co-evolved members of our ancestral component community...places them in a biologically and ethically distinct class from ‘wild’ species” (p. 33) and out of reach of moral consideration. Henk Verhoog (1992: 156) corroborates the environmental ethics tendency to divide wild and domesticated species along these value lines and notes that, “once domesticated, species become morally outlawed as a species, because they are no longer ‘natural’”.

Making species morally considerable has other implications. Not only do humans have to ensure that a species does not become extinct, that their numbers and frequency do not diminish, and that their habitat types are preserved, but they are also bound to ensure that its individual members are not transformed so as to no longer be an exemplar of their kind. Moral concern about the continuation of species is also a concern about species *integrity*¹¹⁴. A genetically or environmentally induced change of an individual is an interference with that individual’s species integrity. Species integrity is also commonly referred to using the Aristotelian concept of *telos* (Rollin 1998; Hauskeller 2005), and interference with it amounts to the removal of one instance of the species. The concept of species integrity, or

¹¹² The significance of these comments is revisited in Chapter Four.

¹¹³ An exception is the absence of any expressed reference to wild/domesticated status in Lawrence Johnson’s (1983, 1991) thesis that species are morally considerable individuals with non-reducible interests, although his treatment of ecosystems indicates that wild nature is the intended subject.

¹¹⁴ See Chapter Four for a more detailed discussion on species integrity.

telos, is typically invoked in relation to proposed biotechnological modifications of domesticated species, usually animals. Its meaning is not fixed – for some it relates to the species-specific needs that underlie animal welfare concerns (Rollins 1996, 1998), for others it provides a limit to infringements that go beyond well-being (Verhoog 1992; Thompson 1997a) – and its applicability to highly changeable domesticated plants is uncertain. In a specific discussion of domesticates in relation to agricultural genetic engineering, Rolston (2002) continues to preference natural over artificial selection and defines species integrity as the level of a species' adaptation to, and fitness within, the wild environment¹¹⁵. Reduced ecological fitness is a characteristic of domesticated plants, and indeed is one of the factors that suppress their spread into surrounding wild populations and protects the ecosystemic value of wild places. This use of the wild as the benchmark for determining species integrity implies that domesticated species are already, by definition, a species with reduced integrity.

Domesticated plants and the intrinsic value of ecosystems

Domesticates are morphologically distinct from wild plants but there is also a spatial element to the differences between wild and domesticated plants. Wild plants typically occur in wild areas and, although some are taken into cultivation, such as the wild blueberry, the wildness of wild plants is usually discerned at the level of environment. A plant is perceived as wild once it is determined to be genetically wild and as 'belonging' in a particular wild area. This means that it has come to be what and where it is through natural evolution and not through deliberate human intervention. Domesticated plants, on the other hand, 'belong' in agricultural fields and horticultural gardens. Their environments are constructed and maintained by significant human and machine labour. Annual crops grown on large acreages employ chemical means to remove unwanted vegetative cover and to keep insect and vermin life from the fields.

Though the artificiality of the domesticate's environment is apparent, the outdoor agricultural field¹¹⁶ remains an ecologically embedded system, dependent on climate, sunlight, rain and the unseen labours of soil organisms – not to mention the biophysical properties of the food plant itself – for the success of the crop. The agricultural and horticultural production system also provides (mostly unwelcome) input into the surrounding wild and semi-wild ecosystems. Chemical fertilisers and pesticides run off into

¹¹⁵ Examined in more detail in Chapter Four (pp. 121-123).

¹¹⁶ The indoor field is barely, if at all, dependent on such elements (bar sunshine), and is becoming an increasingly common infrastructure for the production of food within which domesticates 'belong'. A case in point is the 'field of plastic' greenhouses in Almeria, Spain, that cover between 90,000 and 100,000 acres (Tremlett 2005).

streams to affect fish, plant, bird and mammal life, and impact on those insects and animals that use the field for habitat. The 'fit' of an industrial agricultural system with its surrounding ecology is usually measured by its capacity to contain such pollutants and minimise its environmental impact through reduced or targeted chemical use, buffer zones, and better plantings. A more stringent interpretation of sustainable agriculture involves the application of ecological concepts and principles to the design, development and management of food production. The fit of the system with the surrounding wild nature is measured not only by the effective containment of its pollutants – or even their total exclusion from the system – but by its internal mimicry of wild ecosystems. Although domesticates appear to be most at home as the productive elements of large-scale industrial agricultural and horticultural enterprise, they can equally belong in permacultural and agroecological environments, and at smaller scales. However, they are not considered to belong within the ecosystem proper, and so are typically not included in ethical theories that are based on the value of ecological integrity.

The most prominent ecocentric ethic¹¹⁷ is J. Baird Callicott's communitarian holism, which translates Aldo Leopold's land ethic into a non-anthropocentric intrinsic value theory. Leopold's proclamation that "a thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise" (Leopold 1949: 224-225) has been interpreted by Callicott as indicating that the biotic community, or ecosystem, is the locus of intrinsic value in nature¹¹⁸. Just as Rolston's biocentric holism subordinates the individual to the species, Callicott's schema subordinates the individual to the biotic community, although the extent of this subordination has lessened somewhat over time (Lo 2001), perhaps in response to criticism that it was overly misanthropic (Regan 1983).

The place of the domesticated organism within an ethic that places value on wild ecosystemic integrity above all else is not promising. In Callicott's ethic, the individual has value in regard to the extent of their contribution to the holistic good of the biotic community. This holistic good is intrinsically valuable and is to be protected, even by the culling of species – wild or domesticated – that threaten its integrity, stability and beauty. Therefore, the place of domesticated plants in this schema is only that of exotic intruders,

¹¹⁷ Although recognising intrinsic value at the level of the ecosystem is also part of Rolston's systemic ethic, where the good of the individual organism depends on its integration into the ecosystem, and "[t]he competing, exchanging, and intermeshing of goods in an ecosystem means that the goods of organisms are contextually situated. The value first concentrated on individuals now fans out from the individual to its role and matrix" (Rolston 2002: 7).

¹¹⁸ Callicott has been criticised for interpreting this statement to mean that the biotic community was the locus of intrinsic value and not simply that it should be the focus of conservation efforts in order to best protect the overall values of the area (Norton 1993).

which, under this ethic, humans are morally obliged to remove. In criticism of industrial agriculture, Callicott (1990) catalogues its destructive impact on wild nature and iterates Leopold's vision of an agroecology that replicates the nutrient cycle of natural ecosystems in a call for agriculture to be more in tune with ecological principles. An ecocentric ethic prioritises for the preservation of substantial areas of wild nature. Agriculture and its composite organisms are of interest only to the extent that they impact upon this objective. Thus, the development of organic agricultural models that eliminate such impacts would be undertaken to preserve the integrity of the surrounding ecosystems and be a 'right' thing to do according to the land ethic.

It is unclear whether Callicott's (1989) recognition that humans' obligations to others are directed by the intimacy of the communities of which they are a part would invite a revised consideration of the domesticated realm as the nature with which humans have more interaction. His proposed concentrically circular model of progressively inclusive nested communities, "each of which has a different structure and therefore a different moral requirement" (1989: 55), is made up of inner circles comprising family, friends, neighbours and human society, an outer circle containing the whole biotic community, and a 'mixed community' of humans and their domesticated plants and animals that lies in between. The moral requirements of this middle circle are not elucidated. However, part of Callicott's objection to biocentric approaches to intrinsic value as being too inclusive is the criticism that "no theoretical justification is provided for differential treatment of wild and domestic organisms" (1984: 301). Earlier, Callicott (1980) argued that domesticated animals not only threaten the ecological community, but have been 'debased' (p. 335) by the selective breeding that is constitutive of their domestication: "They have become ... 'animal machines'" (p. 335), such that any recourse to the 'natural' behaviour of chickens and calves "would make almost as much sense [as] to speak of the natural behaviour of tables and chairs" (p. 332)¹¹⁹. At the time, his solution to this, and to the impact of industrial husbandry on the surrounding biotic community (of which domesticated animals are not a part), was to "resist factory farming in all its manifestations" (p. 336) and so minimise the domesticated environment to the smallest scale and advocate a return to hunting and gathering wild foods. Whether or not domestication and its biological products still feature as a source of disvalue in Callicott's concentric circle approach, it remains that the domesticated landscape is not considered to be part of the biotic community that his ecocentrism intends to protect.

¹¹⁹ Whether this conflicts with his later statement that "[o]nly the most irritable non-anthropocentric ethicists have complained on moral grounds about the genetic manipulation of animals through traditional methods of selective breeding" (1990: 37) depends on whether this perceived debasement is a moral or a merely aesthetic concern, and whether he identifies with the charge of being irritable.

Domesticated plants and the intrinsic value of nature's autonomy

The approaches to non-anthropocentric intrinsic value outlined above differ in terms of the ecological level of organisation they recognise to hold intrinsic value¹²⁰, but are all concerned with nature that is alive. Rivers, streams, rocks and dirt are only valuable instrumentally when they provide intrinsically valuable beings with the infrastructure and means to go on living. A fourth position, advanced most prominently¹²¹ by Eric Katz (1997), argues for the intrinsic value of all natural entities – whether biotic, abiotic or exbiotic – on the basis that what is intrinsically valuable about them is their fundamental autonomy from human influence. The source of nature's intrinsic value is its genesis in natural evolution. Nature has not been designed and does not exist for humans; it is an end in itself.

Katz's inclusion of all naturally formed entities within his criterion of intrinsic value also allows him to exclude non-naturally formed living entities from moral consideration more decisively than biocentric approaches. All objects other than those naturally formed through evolution are human artefacts. The artefact compares unfavourably to the natural biological organism in terms of the extent to which it can be accorded, or recognised as possessing, the inherent value of an organism existing as an end in itself: "[i]n contrast to natural entities, artefacts, as human instruments, are always a *means* to the furtherance of some human *end*" (Katz 1997: 129). Thus they are seen to have only instrumental value, and are otherwise excluded from moral consideration. For Katz, the intrinsic value of the wild organism is in part deduced from its positioning in ontological opposition to the artefact, which exists only as a means to a human end. The natural world is valuable because it has no function, because, in Andrew Brennan's (1984) words, it is full of 'good for nothings'.

The key question to the place of the domesticate in Katz's schema is whether domesticated plants are natural or artefactual¹²². Certainly for Katz, whose key argument that replanted forests are artefacts seems to cast a wide net in terms of assigning artefactual status to biological entities, the answer is simple. Domesticated organisms were created by humans in

¹²⁰ And in regard to where the *source* of this value is thought to lie. Taylor and Rolston argue that the intrinsic value is objective and exists independently of a human valuer, while Callicott contends that intrinsic value is subjective and lies within humans as the valuing subjects. One proposed resolution of this epistemological dilemma is Lee's (1996) dissolution of the objective/subjective distinction, and description of human values as 'articulated values' and environmental values as 'mutely enacted values', "occurring every time natural beings succeed in maintaining their own functioning integrity" (p. 308).

¹²¹ Robert Elliot (1997; *cf* Light 2003) also makes strong use of the nature/artefact framework in assessing the value of restoration ecology. Elliot draws an analogy between the lesser value of restored nature and the lesser value of forged artwork as compared to the original. The emphasis in Elliot's distinction is on the *falsity* of presenting and experiencing restored areas as though they had evolved independently. His conceptualisation of the nature/artefact distinction is quite specific to the case of restored nature, and less transferable to the case of domesticated nature than Katz's formulation.

¹²² See Chapter Five for a detailed consideration of this question.

order to meet exclusively human purposes and thus are artefacts. They are no longer natural and therefore they lie outside the scope of environmental ethics. Katz calls domesticated animals “human created entities [that] have no place in an environmental ethic since they are not natural entities” (1993: 229). Artefactual nature is of interest to Katz’s ethic, though, because it represents a threat to real nature. As in Callicott’s land ethic, domesticates are a source of pollution. More than this, domesticated and other artefactual nature can replace real nature – through Katz’s restored forests, or through the replacement of wild food stands with domesticated landscapes. When artefactual nature takes up space that would otherwise be occupied by wild nature, we suffer the loss of nature as an ontological category (Lee 1999).

Domesticated nature and intrinsic value

There are three central ways that the domesticated plant features in mainstream non-anthropocentric intrinsic value theory. The first is that its modification by humans is considered significant enough to mean that it is no longer a part of nature. Therefore, it is of no concern to the field of environmental ethics except as a potential source of biological, genetic or chemical pollution of real (wild) nature. The second is an adjunct to the first; if domesticates are no longer natural, they are artefactual, and as artefacts they represent a direct ontological threat to nature. The progressive replacement of real nature by artefactual nature makes the domesticate *qua* artefact a source of disvalue in the natural world. Domesticated nature in both these scenarios is only valued instrumentally insofar as it can bring about positive states for wild nature by leaving no trace of itself, or create desirable outcomes for humans by producing a quality abundance of food. In and of itself it has no value.

The third way that domesticates are accounted for in intrinsic value theory does include them in an environmental ethic. It can recognise their intrinsic value to the extent that they resemble wild nature. Domesticated nature is organised into species, is ecologically embedded, and its constituent organisms are ‘teleological centres of life’. Despite this, the inclusion of domesticated nature as intrinsically valuable alongside wild nature is incidental at best. However, even where it can be included, this is not very practical given the moral implications of intrinsic value. It is commonly agreed that something’s possession of intrinsic value generates a *prima facie* moral duty to protect it, or at least refrain from damaging it. Any account of domesticated nature as intrinsically valuable obliges humans to treat domesticates with a kind of respect that is difficult to reconcile with its instrumental use. Through the practices of agriculture, domesticated plants are artificially sown, liquid fed and chemically defended, before they are mechanically harvested and uprooted. The

practices of domestication itself are even more interventionist. Producing a more desirable cultivated food source is a deliberate and methodical process, particularly in the contemporary context. It requires careful selection, calculated pollination, selective removal of reproductive parts, even the exposure of plants to mutating radiation and their genetic material to molecular injection. The question remains as to how the use and modification of nature that is inherent to domestication can be reconciled with any intrinsic value domesticated plants might have, and whether the intrinsic value directive that “[w]e should be accountable to ... living beings independently of the value that they represent for humans and other living beings” (Rippe 2001: 12) is able to be fulfilled.

The problem of reconciling the intrinsic value of nature with its instrumental use is persistent, and is a key aspect of broader criticisms of intrinsic value theory: “[i]f respect for nature means leaving nature alone, then using nature involves disrespecting it and at best we can minimise our disrespect by using it as little as possible” (Hettinger 2005: 94). Piers Stephens (2000: 272) regards intrinsic value “without any reference to any conceivable human experience as over-abstracting”, and under a strict reading of the ethical implications of intrinsic value, “[r]especting nature would seem to require us to jettison civilisation and live in wilderness” (Hettinger 2002: 113). Accordingly, Callicott has said of non-anthropocentric intrinsic value theory that it needs to, *inter alia*, “provide differential intrinsic value for wild and domestic organisms and species” (Callicott 1984: 299). Presumably, Callicott intends to attribute greater intrinsic value to wild over domesticated nature, a difficult objective that Regan (1992: 180) cites as evidence that conceptualising nature as an ‘end-in-itself’ is a ‘mistake’: “because end-in-itself theories treat intrinsic value as a categorical concept, with the consequence that no one intrinsically valuable entity can be more or less intrinsically valuable than any other, such theories must fail in grounding the differential intrinsic value of what is wild and what is domesticated”. A non-anthropocentrist might point out that the importance of recognising the intrinsic good of each being is to bring them into the moral domain, where previously they were morally inconsequential; their treatment need not be necessarily egalitarian. The range of critical responses to intrinsic value theory (for example, Norton 1992; O’Neill 1992; Regan 1992; Green 1996; Feldman 1998; Gruen 2002): that it offers no clear way to discern between competing interests; it has a confusing array of meanings¹²³; and that its moral implications make it incompatible with the use of nature, are even more pronounced with the recognition of intrinsic value in domesticated nature.

¹²³ Intrinsic value can mean that the possessor of this value is an end in itself, that it has valuable intrinsic properties, or that it has objective value.

Although intrinsic value theory is explicit in barring human interference in the processes and objects of nature *qua* wild nature, the question of what exactly constitutes interference is yet to be comprehensively laid out¹²⁴ (Michael 2001, 2002). The obligation of non-interference that accompanies the recognition of intrinsic value¹²⁵ usually relates to exercising restraint over our resource use in order to protect against the cumulative effects of over-harvesting natural resources. Acceptable interference with wild resources requires regulation of the quantitative impact of activities like collecting timber from forests, fish from wild stocks, or water from free flowing rivers, and is a matter of sound resource management to ensure the continuation of, and sustainable access to, these resources. Where wild nature falls within the boundaries of wilderness areas or other protective legislated zones, the principle of non-interference limits human activities by disallowing the use of motorised vehicles, the release of human-generated wastes, or physical impact on plant life and landscapes (Havlick 2006). The deep ecology directive that we ‘have no right to interfere destructively with non-human life except for the purposes of satisfying vital needs’ is a neat summation of the effect of recognising intrinsic value in wild nature, but the absence of further detail about the acceptability of the differing levels of interference that do go into ‘satisfying vital needs’ appears to endorse a program of unlimited interference in the instrumental use of nature. Along with heavily resourced undomesticated nature like plantation forests and strip-mined landscapes that lie outside protected zones, domesticated nature is situated firmly in a ‘sphere of use’ that is offered no protection from excessive interference. Val Plumwood (2001, 2002) recognised this as a consequence of the division of the natural world into two moral domains – the domesticated nature that we use (the sphere of use), and the wild nature that we (ought to) revere (the sphere of reverence) – which has proved problematic for the development of a comprehensive and instructive environmental ethic.

Proposals for separate ethical treatment of the wild and the domesticated, like Taylor’s delineation of the bioculture from real nature based on the necessity of human use of the latter, are not uncommon¹²⁶. Writing in defence of the primacy of wilderness and the wilderness concept for environmental ethics, Philip Cafaro (2001a: 5) differentiates between

¹²⁴ Richard Sylvan (formerly Routley) recognised in 1985 the need for environmental ethics to offer some interpretations of what interference might mean, and to consider a classification of the degrees of interference and their relative effects on natural and intrinsic value.

¹²⁵ Notwithstanding the common criticism of intrinsic value that it is not necessarily morally obligating (for example, O’Neill 1992).

¹²⁶ Agricultural issues are taken up separately in the field of agricultural ethics, which meets environmental ethics in the *Journal of Agricultural and Environmental Ethics*. This collaboration is producing interesting work in the context of biotechnological advancement in agricultural production, but tends to steer away from deontological content, with some exceptions (see Myskja 2006; Melin 2004; Heeger 2000; Hale 2006; on virtue ethics see Sandler 2004).

our ethical responsibilities toward domesticated and wild organisms: between “those entities that we treat well by taking care of them and cultivating close personal ties, in a process whereby they and we lose some autonomy; and those entities that we treat well by restraining our very human desire for relationship, appreciating them at a distance and setting up places where they can be largely free from us”. Ascertaining the proper treatment of the domesticate remains the concern of environmental ethics, irrespective of statements to the contrary. Aside from Callicott’s (1980) sentimental suggestion to decrease the size of domesticated sphere, few are seriously advocating a return to hunter-gathering on moral grounds to right the wrongs of domestication as the original incursion into wildness (cf Turner nd, 1996). The recent and quite deliberate domestication of the Chinese gooseberry into the New Zealand Kiwi fruit, for example, was not cause for environmental concern. It did not in itself threaten the indigenous environment nor the organismic integrity of the remaining wild *Actinidia deliciosa*. Domestication *per se* appears to be objectionable where it is seen as an act of domination over nature, and where the results of this domination are a diminished, inferior version of real nature.

Domestication as domination

Domestication has been conceptualised as a process of domination in two significant ways. In the first, it appears as an exemplar of the instrumental relationship to nature that is a matter of concern to environmental ethics. The agroecosystem itself forces “the productive energies ... to serve more exclusively a set of conscious purposes located outside it” (Worster 1990: 1094). Agricultural labours are ecologically successful, not because of their similarity to existing ecological systems, but because humans were able to put the natural properties of those systems to instrumental use. At the top end of this instrumentalism is the development that signifies the shift from early agriculture to domestication proper. This advancement extended the human sphere of control beyond the mere alteration of the environment of the food plant and into the more fundamental biological level of the alteration of its very characteristics as an organism (Goodman, Sorj & Wilkinson 1987). Domesticated nature is now situated securely in the sphere of use, is necessarily manipulable and manipulated, and derives its only value from anthropocentric assessments of its agronomic, economic and culinary worth.

The second way that domestication is regarded as domination is with respect to the historical role of the original Neolithic process of domestication in the material and conceptual separation of humans from nature. The pejorative possibilities of this vision are made explicit in Paul Shepard’s (1993, 1998) deep ecological writings on agriculture as a kind of primordial fall from grace that lies at the core of contemporary environmental crises.

It is inadvertently supported by standard anthropocentric definitions of domestication and classic archaeological literature on agricultural origins that emphasise human mastery over nature. Domestication is “the human creation of a new form of plant or animal” (Smith 1995: 18) through which humans became “masters of their own food supply” (Verhoeven 2004: 42). It began as “that revolution whereby man ceased to be purely parasitic and, with the adoption of agriculture and stock-raising, became a creator emancipated from the whims of his environment (Childe 1928: 2).

In the case of animal domestication, animals were “kept and bred in and around human habitation to be used constantly to human advantage” (Hemmer 1990:1), so that the relationship was transformed from “one of mutual trust in which the environment and its resources are shared to total human control and domination” (Clutton-Brock 1999: 31). The problem of domestication is not only that it exemplifies such instrumental relations, but that it dislocates humans from wild nature to the detriment of environmental and cultural wellbeing. Shepard (1998: 103) asserts: “if there is a single complex of events responsible for the deterioration of human health and ecology, agricultural civilization is it”. The history of domestication is, in this view, a story of cultural and spiritual impoverishment:

[b]oth pastoral and agricultural societies required political decentralisation and a warrior class for their expansion and perpetuation. They violently suppressed foraging peoples, supplanted their cultures with cultures in which people had little contact with nature and less ‘attentiveness’ to it, turning the world into a ‘thing’ instead of a ‘presences,’ widely destroying animistic spirituality and ethical sensitivity toward nature (Taylor 2000: 272).

Shepard argues that the ‘wilderness’ habitat of the Pleistocene era of hunting and gathering is humanity’s true home. We are, in essence, wild and have only been tamed to live in the domesticated landscape. Our capacity to belong in the wilderness has been lost through the long term agricultural subjugation of the natural world, that has been directed by the will to control:

[o]nce humans became agriculturalists, the almost paradisiacal character of prehistory was irretrievably lost ... Rather than attempting to live in harmony with wild nature, as hunter-gatherers had done since time immemorial, farmers literally rose up and attempted to dominate the wilderness (Oelschlaeger 1991:18).

Ralph Acampora (2004: 219) recognises the broad tendency to “disparage or demonise domestication” in the literature. This tendency is exemplified in a cosmology that casts agriculture and the domesticatory relationship as the cause of environmental crises, and which features either explicitly or implicitly in determinations of the natural value of domesticated nature.

Bringing the domesticate in

Environmental ethics, while it provides some of the necessary conceptual resources for an examination of the value of domesticated nature, has hitherto not offered a positive account of either the relationship of domestication or the organisms it produces. Similar critiques of the narrow scope of the field have been offered by Fox (2000, 2006), Light (2001) and King (2003). Fox and Light argue that environmental ethics needs to take account of urban and built environments, while King specifies the domesticated character of these places and contends that closer attention to the value of domesticated spaces will facilitate a greater appreciation for wild nature. Typically, the environmental units nominated for consideration by these affirmations of the environmental value of cultural landscapes are spatial locations. This thesis is concerned with particular kinds of biological entities that inhabit agricultural and horticultural landscapes – domesticated plant organisms and species – and their neglect in the environmental ethics literature.

King's (2003) argument for the inclusion of domesticated spaces identifies as neglected those designed places where nature and humans coexist: industrial, urban, semi-rural, cultural environments that stand in contrast to the wilderness landscapes that concern conservationists. These are spaces where humans regularly interact with nature: in private gardens, in public spaces, on pavement cracks and railway tracks, in city streets, country roads and suburban parks. Human cohabitation with trees, grasses, shrubs, crops, flowers, weeds, small scurrying mammals, nesting marsupials, insects, birds and pets has escaped notice in the project of building ethical relationships between humans and nature. The wild nature that is of interest to environmental ethics is geographically, biologically and aesthetically distinct from these domesticated landscapes. Yet, "the domesticated is *our* space" (King 2003: 6). King contends that the way people experience and relate to their local nature institutionalises, routinises and embodies the way they value wild nature. In the absence of a meaningful relationship with nature in our own space, it is more difficult to develop an ecological sensibility on behalf of distant and unfamiliar wilderness: "[i]f people live in a domesticated environment that is degraded and cut off from nature, then it is plausible to think that they will be less motivated to value changes needed to protect a wild nature they know nothing about" (p. 4). King calls on environmental ethics "to find ways to loosen the hold of the wild-domesticated dualism and to embrace study of the human-made artificial world, as well as wild nature" (p. 7), but this criticism of the wilderness bias is chiefly one of method. The ultimate reason that greater attention should to be given to King's domesticated spaces is not for the sake of the resident nature itself, but in order to create a more effective concern for real, wild nature. In a similar vein, Light's (2001) call

for more attention to urban environments goes beyond a vision of sustainable cities and a need for widespread meaningful contact with the natural world that does not impact destructively on wilderness areas. Positive experiences of local urbanised nature will build an ecological literacy to facilitate an understanding of the importance of wilderness preservation, as similarly scaled ecological restoration projects (Light nd).

Warwick Fox (2000, 2006) argues that the built environment (and indeed ‘mixed’ environments where “humans intentionally engineer and put to use the spontaneous, self organising processes of the natural world” [2000: 2]) is a blind spot in environmental ethics that is on par with the blind spot in traditional anthropocentric ethics about the natural environment. In answering the question he asks of this ethics, “[w]hat else is there besides humans on the one hand and everything else on the other?” (2006: 4), Fox proposes a more inclusive definition of ‘environment’ as comprising nature, and humans and their constructions. Through this reconfiguration, the scope of environmental ethics is revised to the extent that it is ultimately repositioned as a cohesive element of Fox’s proposed Theory of General Ethics. The focus of this relationally-based ‘ethics of everything’ is naturally wide ranging, though it does provide detailed direction for ascertaining the ethics of built environments with regard to what he terms their ‘responsive cohesion’, or the extent of their reciprocity with their various contexts. Domesticated nature is valuable in terms of the responsive cohesion of humans’ biophysical needs, their social, agricultural and culinary practices, and their relationships with other significant beings¹²⁷.

Fox uses the ethical coverage of the built environment as both the starting point and the litmus test for his General Ethics, though his spatial focus as a result of this revision becomes wide-ranging to the point of being non-specific. The focus of King and Light remains trained in particular on the neglect of urban spaces in environmental ethics. In this thesis, concern is specifically targeted at the organismic level at food plants that have been modified by domestication and are situated in rural and domestic landscapes. I am in agreement with Light and King that respectful consideration of domesticated/urban environments is likely to encourage greater ecological awareness and further protection of wild places, and support Fox’s resolution that it is vital to maintain a physical limit to the spread of domesticated landscapes to protect against the destruction of wild nature. I also contend that an environmental philosophy engagement with domesticated nature remains a valuable contribution in and of itself.

¹²⁷ Though on the moral considerability of domesticated nature *per se*, this ethics does not differ considerably from the standard position. The moral limit of domestication is reached when domesticated nature outstrips and displaces wild indigenous nature, as “the domestication of living things and beings should not actively detract from the responsible cohesion of our biophysical base context” (Fox 2006: 318).

Specifying the moral dimension of humans' relationship with nature is, indisputably, the task of environmental ethics. Rolston (1998: 13) concedes this in noting that "[a]n environmental ethic is not just about wildlands, but about humans at home in their landscape". When Richard Routley announced the original need for the field, he cited Leopold's much earlier call for an ethic "dealing with man's relation to land and to the animals and plants which grow upon it" (Routley 1973: 205), and himself described the role of environmental ethics as "setting out people's relations to the natural environment" (p. 205). If environmental ethics is placed to problematise and resolve the moral relationship of human beings to the environment, domestication is the relational quandary *par excellence*.

A focus on domesticated plants is supported by calls within the field for a more positive vision of humanity's place in nature (Hettinger 2002, 2005). Hettinger calls for environmental philosophy to conceive of a constructive human relationship with nature that can inform an ethic of use, restating John Visvader's (1996: 18) plea to "imagine giving more to the world around us than the gift of our mere absence". Given that the domestication of food plants for agriculture is *the* necessary intervention in nature for 'the purposes of satisfying vital needs', it is a good place from which to respond to Hettinger's call.

The popular reframing of domesticated nature as a subject for environmental ethics consideration in the context of biotechnology only makes this task more urgent. While the guiding principle of non-interference precludes an optimistic account of humans in nature (Hettinger 2005), any positive treatment of domestication would need to critically revise the doctrine that human interference is always a loss for nature, and give more consideration to the subtle gradations and effects of different kinds of human presence in nature. The recent controversy and ongoing discontent over the use of genetic engineering to modify agricultural and horticultural food plants indicates a persistent moral dimension and, indeed, a moral limit to domestication on the basis of the naturalness of domesticated plants and animals. Appeals to 'nature' for moral legitimacy are made by both sides of the genetic engineering debate, and the claim that the technology and its products are unnatural is met with particular retellings of domestication and the trajectory of agriculture that iterate a normative status for domesticates and the people-plant relationship. Genetic engineering imbues conventionally domesticated plants with a renewed naturalness that inadvertently brings the domesticate back into the fold. Accordingly, new attempts have been made within environmental ethics to account for the moral status of domesticates¹²⁸, with some making efforts to apply intrinsic value theories (Verhoog 1992; Balzer *et al.* 2000; Verhoog 2001).

¹²⁸ See Chapter Four.

Providing a conceptual understanding of less-than-wild nature and sound reasons to maintain respectful relations with it is indeed a “crucial task for environmental philosophy” (Hettinger 2005: 86) if it is to be comprehensive and remain instructive in the biotechnological era.

Bringing the domesticate in as a subject for moral concern represents a challenge to the privileging of wild nature that provides opportunity to revise the treatment of nature and culture as pure categories. In the contemporary Western world at least, the mutual exclusivity of the wild/domesticated dichotomy maps readily onto the problematic nature/culture dualism. Domesticated nature is not considered a subject for environmental ethics because it is situated firmly in the realm of culture, both because it is degraded nature and because it is food. Notwithstanding traditional hunting and gathering practices¹²⁹, interventions to produce food can only take place in the sphere of use, and, given “that food is inevitably a site of domination, degradation and exclusion, ethical food practice must consist of ensuring that nothing morally considerable can ever become our food or ontologised as edible” (Plumwood 2002: 156). The use/respect dichotomy is ethically polarised and does not allow organisms that are regarded as possessing natural value to be used instrumentally for food production. The deeper nature/culture dualism that this arrangement reflects has been subject to much critical attention (Haila 2000; Stephens 2000), and is difficult to maintain in light of the material imbrication of its constituent categories (Whatmore & Thorne 1998; Whatmore 2002) and the recent problematisation of its ontological assumptions (Vogel 2002; Castree 2003c; Vogel 2003). An environmental ethics appreciation of domesticated nature that seeks to move beyond dualistic approaches to understanding human-nature interactions can provide a response and contribution to such critical literature and remedy the strong ethical discontinuity at the wild/domestic boundary.

Conclusion

Environmental ethics has tended to maintain an exclusive focus on wild nature to the neglect of other landscapes, organisms and relationships that may fall within its scope. The seminal goal of providing philosophical grounds for protecting wild nature from human activities and industry, and preserving the independent workings of wild organisms, species and ecosystems went hand in hand with the rejection of human-centred ethical theories as the

¹²⁹ Contemporary people do continue to locally collect and commercially exploit many wild foods – from hunger foods that require labour intensive preparation, to wild staples of berries, nuts, weeds and fungi to luxuries like caviar, truffles, game and seafood (Evans 1996). However, domesticated plants and animals remain those organisms that humans have significantly influenced through their mutual participation in an ecologically intimate relationship over a long period of time.

cause of these intrusions. The expansion of intrinsic value from being possessed exclusively by humans and, later, sentient animals, to being recognised in non-sentient inhabitants of natural areas, has constituted a significant portion of mainstream environmental ethical thought, particularly in its first 20 years. Domesticated nature has either been explicitly excluded from moral consideration by this schema, or included to the limited extent that it resembles wild nature. Set in contrast to the valued wilderness landscape, domesticated plants are variously referenced as potential sources of pollution, organisms that have been modified by human practices and desires so as to be longer natural, or human artefacts that are a source of disvalue for nature. Where domesticated nature is able to be accorded intrinsic value to the extent that it resembles wild nature, this valuation is vulnerable to the recognised limitations of non-anthropocentric intrinsic value theory, specifically with respect to meeting the moral obligation of non-interference.

As domestication necessarily entails the instrumental use and modification of nature for human ends, it tends to be regarded as an exemplar of the kind of instrumental, anthropocentric engagement with nature that environmental ethics traditionally eschews. This view is iterated in particular understandings of the history of domestication as an impoverishing human domination of nature, within which the role of agriculture in the original and ongoing separation of humans from nature is implicated in contemporary environmental and spiritual crises. The disvalued place of both domestication and domesticated nature in environmental ethics reflects the logic of the dualistic nature/culture dualism that precludes any positive account of human interferences with nature.

The ethical split at the wild/domesticated boundary allows for the unlimited instrumentalism of domesticated nature in the sphere of use while demanding the strict observation of non-interference in wild nature in the sphere of reverence. However, the certainty of this division has become conceptually challenged from within the field of environmental ethics, and empirically challenged by the widespread protest of biotechnological interference on behalf of the non-use value of domesticated nature. Domestication has been propelled into the moral spotlight by the controversy over agricultural genetic engineering, which as highlighted the pressing, though pre-existing, need for the re-evaluation of the moral status of the domesticate and the ethical dimensions of the domesticatory relationship within the project of accounting for the value of the whole of nature by environmental ethics. The approach taken by environmental ethics scholars to provide an ethical assessment of genetic engineering in agriculture, and the way these works revisit or revise the traditional place of domesticates in the discipline, is the subject of the following chapter.

Chapter Four

Environmental ethics on biotechnology: domestication revisited

Introduction

This chapter critically reviews the engagement of environmental ethics with philosophical issues about agricultural biotechnology and its implications for nature. It is concerned with how this engagement either upholds or revises the traditional place of domesticated nature to provide, or at least prefigure, an ethically instructive account of domestication. As demonstrated in the previous chapter, the main stream of environmental ethics – intrinsic value theory in particular – has dealt with domesticated nature only incidentally or has omitted it from ethical consideration altogether. Agricultural biotechnology disrupts the traditional exclusion of domesticated nature by throwing the moral dimensions of domestication and the previously unrecognised natural value of domesticated nature into relief. It is domesticated nature that is subject to biotechnological intervention and defended in popular protest. It is the process of domestication that is thereby considered to have gone so far in its domination of nature as to have become ‘unnatural’. Contributions to biotechnology debates from environmental ethics quarters necessarily give fresh attention to the place and status of domesticated nature. They figure as an opportunity and a catalyst for the field to revisit its position on domestication and explore and develop an appreciation of the moral dimension of domestication as an intimate and transformative relationship with nature. This chapter will look to which of the conceptual resources used by environmental ethicists in their appraisals of genetic engineering are best able to accommodate the biotechnological reframing of domesticated nature as valuable nature, and best placed to identify the ethical significance of genetic engineering.

Under traditional value theories, genetic engineering, conventional and traditional methods of domestication all feature as instrumental uses of nature, and the resulting nature as the disvalued product of human domination. The grouping together of all domesticatory practices under one morality reflects the logic of the similarity discourse of the popular biotechnology debate, in which positive conclusions about genetic engineering are drawn on the strength of the likeness between biotechnology and conventional domestication. Environmental ethics commentaries on biotechnology tend to iterate this discourse and its

seemingly contradictory recourse to natural—as well as artificial—evolution for legitimacy. On one hand, all human modification of nature through domestication is framed as artificial and value-reducing, while on the other, the shared characteristics of domestication and natural evolution are cited as some sort of moral barometer by which particular domesticatory practices can be judged. On the basis of the latter, the mutability of species through evolutionary time is taken by both biotechnology defenders and environmental ethical analyses as natural precedence for the biotechnological crossing of species boundaries. The tendency of environmental ethics to take up the similarity discourse and derive the morality of genetic engineering from the morality of domestication is problematic. It inherits the logical flaw of assuming that if a distinction between two things is not clear cut then it cannot be drawn at all. It reinforces pre-existing conceptualisations of domestication as a source of disvalue, and, perhaps most importantly, it makes these associations in the absence of a comprehensive model of domestication that recognises its heterogenous natural and cultural elements through time. This last point is a key limitation for an environmental ethics elucidation of the moral dimensions of domestication generally and genetic engineering specifically.

This chapter identifies a number of approaches from the range of appraisals of biotechnology by the field that offer promise in differentiating between domestication and genetic engineering on environmental ethics grounds. Two of these are, for the most part, diffuse in the literature. They are also tentatively, not comprehensively, argued. The first is advanced *via* a general admonishment of genetic engineering as furthering the instrumentalisation of nature. It recognises the existence of a scale of instrumentalism upon which conventional domestication features as a less instrumental treatment of nature than genetic engineering. This seemingly simple move represents a conceptual step away from the default classification of all domestication as equally disrespectful, and toward a more nuanced appreciation of the various human-centred uses of nature that can account for a synthesis of virtue ethics and ecofeminist politics. It also emphasises the significance of domestication as a relationship, rather than as a static state of affairs. The second approach suggests the existence of an equivalent scale in nature by recognising differential degrees of ‘wildness’ in genetically engineered and conventionally domesticated plants. It introduces the idea that domesticated plants retain wild characteristics (beyond the simple fact of being biological entities), and that these characteristics ought to be recognised and valued in the same sense that the wildness of wild nature is recognised and valued. Positive valuations of the retained wildness of domesticates are also at the core of environmental ethical assessments that are concerned with how far biotechnology takes the organism away from its wild state. To the extent that the continued instrumentalisation of domesticated plants

through biotechnological means entails a diminution of their wildness, these arguments represent essentially two sides of the same coin. Both are employed in a preliminary way in the literature and require further development before they can provide a moral framework for domestication. A third area of promise relates to the ontological question of what kind of objects domesticated plants are, and sees an extension of the natural object/artefact distinction to the biotechnological context. These approaches, organised around the themes of naturalness, wildness and relationship, are then taken up in the final three chapters of the thesis.

Environmental ethics and biotechnology: upholding the wild bias

In a relatively early environmental ethics critique of genetic engineering, Andrew Dobson (1995: 228-229) affirmed the role of the field in providing an ethical framework for assessing the acceptability of genetic engineering:

[P]eople often jump all too readily to the conclusion that genetic engineering is simply an advance on techniques of which we have ethical experience, and that therefore no new ethical thinking needs to be done. My contention has two aspects: first that genetic engineering is so sufficiently different from other techniques as to demand new thinking; and second, that biocentric and ecocentric holism introduce a new ethical dimension anyway.

A new ethical dimension is introduced into biotechnology debates by the range of environmental ethics approaches¹³⁰ reviewed in this chapter. As expected, this includes an iteration of the traditional focus on wild nature. Laura Westra (1998: 92) assesses biotechnology negatively in terms of its probable impact¹³¹ on ‘ecosystem integrity’, where “the central necessity is to save and protect wild areas in relatively sizeable proportions”. The potential environmental hazards posed by genetically engineered crops inform the common critique that genetic engineering “constitute[s] a rather clumsy form of intervention in an almost infinite series of delicate relationships on which we depend for our well-being”

¹³⁰ Even though ecocentric thinking provides a framework for valuing wild nature, the protection of wild nature from agricultural and biotechnological pollutants remains a problematic issue in the popular debate because there is disagreement about whether biotechnology can in practice achieve it, not because it is a goal that is not shared (at least ostensibly) by both sides. This has been described as the difference between Type I and Type II ethical problems in agriculture (James 2003). Type I problems occur when the ethical course of action is not in dispute, but assuring compliance by all parties in adhering to the required action is problematic. The protection of wild nature from biotechnological pollution is a Type I problem. A Type II problem is when there is disagreement about the ethical course of action itself. The irreconcilability of in-principle opposition to genetic engineering and those who advocate case-by-case assessment is an example of a Type II problem.

¹³¹ Although Westra deviates from this consequentialist equation in noting that her assessment is guided by an in-principle directive to ‘respect natural evolutionary paths’ and the ‘natural development’ of organisms, it is not made clear what these might mean in the domesticated setting.

(Dobson 1997: 213). Alan Holland's (1990) use of the obligations of Aldo Leopold's land ethic to determine the morality of biotechnology is also concerned with containing the impact of genetically engineered crops on the workings and diversity of local ecological community. Others have offered qualified support for the technology on the basis of its promise of environmental sustainability:

By developing food plants that are tolerant for salt, drought, extreme temperatures and so forth, they can grow in areas where they do not compete with wild plants. Thus, larger areas of nature can be free of human intervention. In this way we treat nature as valuable for its own sake, independently of human needs (Myskja 2003: 5).

In these examples, the very real imperative to protect wild nature from pollution and destruction underlies the default exclusion of consideration of the impact of biotechnology on domesticated nature. In other environmental ethics contributions to biotechnology debates, the reasons for this exclusion are clearly stepped out. The first relates to the broader problem of reconciling the intrinsic value of nature with its instrumental use, and the requirement to deny domesticated nature such value so that life can remain liveable. The second, offered early on by biologist Robert Colwell (1989), using a similar logic to Eric Katz (1993, 1997, 2002), is that there is a lack of value in domesticated nature as a result of its history of strong interactions with humans and this lack of value allows all and any ongoing modifications of domesticated nature. For Katz, domesticated organisms are artefactual, not natural, objects and as such are not protected by an environmental ethic. For Colwell, while any intentional or accidental genetic alteration of wild species constitutes an unwelcome degradation of their intrinsic value, the 'unnatural history' of domesticates leads him to declare that:

unlike wild species, I see no ethical justification for any bar on genetic alteration of domesticates, by whatever technical means. Molecular and cellular techniques permit 'wider crosses' and more rapid and precise alterations, but there is no logical distinction between the use of these techniques of 'applied evolution' and the techniques of classical plant and animal breeding (p. 33).

The inability to distinguish between domestication and genetic engineering on the basis of the similarity of their intent and effect, and of the similarity between changes brought about by genetic engineering and those brought about by natural evolution, is the third reason that is often given for passing over domesticated nature. A key element of environmental ethics determinations of naturalness is the historical evolutionary process through which natural organisms have come into being (Preston 2008). Comparing the relative naturalness of genetically engineered organisms with products of synthetic biology, Preston (2008: 34)

notes that in the case of biotechnology, there is still “a continuous causal chain between the genome currently being manipulated and the historical evolutionary process”. Genetically engineered organisms are still embedded in evolutionary history, and, “since natural selection works by taking an existing viable genome and modifying it incrementally, it seems plausible to characterise many previous types of biotechnology the same way”.

Holland (1990) offered an early review of the implications of biotechnology for domesticated nature with regard to evolutionary theory and Darwin’s specific consideration of the changes undergone by nature under artificial selection. Holland considers that the changes to domesticated nature proposed by biotechnology are unproblematic for two reasons: first, the domesticate has already been substantially changed by human-directed evolution; and second, evolutionary history shows that species in general are genotypically and phenotypically changeable¹³². This logic directly reflects that of the similarity discourse that dominates in popular debates¹³³, though it is from the viewpoint of environmental ethics that Holland asserts there is “no unique argument for rejecting genetic engineering in principle” (p. 174), aside from adhering to the directive that sentient beings do not suffer. In a later paper on technology, Holland (2004) critiques the similarity discourse as a sorites paradox that confuses the difficulty of making a distinction between two things with there being, in actuality, no distinction to make, although he does not revise his earlier soritical conclusion about biotechnology. The similarity discourse reappears in environmental ethics appraisals of genetic engineering with most force in discussions about species boundaries, which are reviewed later in this chapter.

A supplementary factor that upholds the traditional place and status of domesticated nature in environmental ethics reviews of biotechnology is the limited capacity of the field of environmental philosophy to influence the actual outcome of biotechnology progress and provide the ‘expert’ interpretation of the public discourse on the unnaturalness and undesirability of agricultural genetic engineering. It has been acknowledged by philosophers and scientists alike that determinations about the future of biotechnology crops are not, and should not be, in the hands of philosophers but policy makers and social and natural scientists (Sagoff 1988). The global and political nature of the debate means that “[i]t would be naïve...to expect such issues to be satisfactorily settled by philosophers alone” (Dobson 1995: 237). Further, providing an in-principle argument against the development of biotechnology in agriculture on environmental ethics grounds is seen to do little to benefit either the outcome of the debate or the status of the discipline of environmental ethics. In

¹³² Also noted by Preston (2008) and discussed in the latter section of this chapter.

¹³³ The effect of this discourse was the subject of Chapter Two.

much of the genetic engineering debate those concerns that are expressed on behalf of an intrinsically valuable domesticated nature are met with brief reply and largely dismissed as ‘imaginary’, in contrast to ‘real’, issues. There is an overarching political imperative to ensure that robust consequentialist criticisms of genetic engineering, not less defensible deontological arguments, are used in an effective campaign of opposition. Given the additional problem of successfully navigating the conceptual ambiguity of the language of naturalness and unnaturalness, which is how these concerns are popularly articulated, there is a tendency to find against concerns about domesticated nature *qua* nature in ethical reviews of biotechnology. Further, as debates about biotechnology ease and genetically engineered crops become ubiquitous in agricultural field and markets, the construction of a critical environmental philosophy response to biotechnology becomes less and less relevant (Preston 2008). It remains, however, that the particular task of conceptualising nature and the moral place of humanity within it is the expressed focus of environmental philosophy, and genetic engineering does reframe domesticated nature as a natural subject for ethical consideration. Accordingly, environmental ethics theories of natural value are being applied to and revised for domesticated nature. The remainder of this chapter will examine attempts to positively account for the relationship of domestication and domesticates themselves, in the face of their biotechnological modification.

Genetic engineering and the instrumental treatment of nature

It is common in the literature to encounter the critical description of genetic engineering as an instance and/or escalation of the instrumental attitude toward nature. It tends to be made as an aside rather than as the primary argument, after attempts to account for it through other environmental ethical systems have failed, or as a small part of a broader environmental critique of biotechnology. The difficulty for the criticism lies in convincingly differentiating the instrumentalism of genetic engineering from the instrumentalism of domestication more generally. Domestication entails the instrumental use of nature, and conventional plant breeding entails a strongly instrumental attitude toward nature. Inducing variation by exposing plant cultures to mutagenic chemicals and radiation is a case in point. Myskja (2003) notes that, under domestication, “[o]ur primary relation to plants is instrumental”, while the necessary instrumentality of domestication is the basis of Taylor’s separation of the ‘bioculture’ from the biocentric ethical protection granted to the rest of living nature. Yet, just as the biotechnological organism brings the relative naturalness of the conventionally domesticated plant to the fore, it seems the genetic engineering of crop plants has brought the purely instrumental treatment of crop plants into light, and into distaste. The extent of instrumental thinking about, and use of, nature is one standard against

which domesticatory practices, specifically, genetic engineering, are judged. After determining that there is little in the environmental ethics literature to support an intrinsic objection to genetic engineering, Myskja concludes that the “genetic modification of plants is acceptable as long as it does not involve a merely instrumental view of nature” (2003: 1). Holland’s (1990) early review of genetic engineering employed the framework of Leopold’s land ethic to determine the acceptability of the technology. The directive of the land ethic is “that [genetic engineering] be conducted in a manner compatible with the continuing existence of the biosphere viewed as a community” (1990: 167), and the recognition of the biosphere as a biotic community carries with it a moral obligation to treat fellow community members with respect. For Holland, any treatment of a domesticated life form that disregards the utilised life form’s own ends is excessively instrumental and is not compatible with respect. On these grounds, Holland argues that the best case against genetic engineering would be that it treats food-bearing organisms instrumentally *in a way that conventional domestication does not*.

Dobson’s reviews of the significance of biotechnology for environmental ethics (1995, 1997) present biotechnology as inherently and excessively instrumental. Indeed, the instrumental view of nature is “exemplified by the very nature and practices of genetic engineering” (1997: 219), and biotechnology is described as “a practice that expresses a human will to domination of the non-human natural world” (1995: 234). This domination is not regarded as characteristic of domestication *per se* (as it effectively is in Paul Shepard’s [1973, 1998] unsympathetic cosmology of agriculture). Myskja (2003) similarly asserts that genetic engineering entails a qualitatively different kind of instrumental use and attitude to nature than domestication. Dobson (1997: 230) argues, *contra* the discourse of similarity, that “genetic engineering and genetic selection are only similar in the same sense that walking and space travel are both forms of locomotion” and criticises Holland’s application of the land ethic to biotechnological question for being “radically underspecified” (p. 232). Yet, in answering his own case, Holland concludes that genetic engineering is a no more instrumental treatment of nature than domestication, that is, that domestication is as equally an instrumental use of nature as biotechnology. They both modify nature for human benefit, and the only difference between these modifications is temporal in nature. However, Holland does take pause to consider that the difference between the instrumental treatment of an organism that still allows it to have its own ends, and instrumental treatment that disregards another’s ends entirely, may be relevant to the case of genetic engineering. This is linked to the question discussed in the last section of this chapter of whether the products of biotechnology are still ‘natural’ in the sense of having their own identity.

As was noted earlier, instrumentalism is “a philosophical attitude toward nature that goes beyond a mere account of nature as being instrumentally valuable toward humans” (Lee 1993: 334) and into the ideology of rightful human domination of the natural world. At its extreme, instrumentalism is a marriage of the anthropocentrism of human-centredness and the unvarying prioritisation of the use of nature for human needs over all others. Lee (1993) describes two types of instrumentalism in a critical examination of Routley’s famous Last Person Argument, in which Routley (1973) proved the intrinsic value of nature by demonstrating the immorality of destroying nature even when there were no humans left to enjoy it. The Last Person Argument described the final disappearance of nature *via* its deliberate destruction by the last human/s. But the wanton material destruction of nature is not in itself an instrumental use of nature; it does not necessarily achieve a human end or project. An alternative Last Person scenario in which “the very numerous last people set about using, transforming, and destroying all of nature to promote their material well-being, making sure that by the time they expire that nature as such has vanished,” would be more instructive, as this is what is at issue in discussions of instrumentalism and what people do as a matter of course. The destruction of nature in Routley’s argument is described by Lee as ‘strong instrumentalism’ under which “it is (always) justifiable for humans to use nature to promote ends or projects that will improve human material well-being. In other words, every possible use of nature in pursuit of such an ultimate goal is in principle justifiable because nature’s value for humans lies in its use or potential use for humans” with no “empirical limitations” (Lee 1993: 334). ‘Weak instrumentalism’ still involves the use of nature but outside the excessive resourceist mindset of strong instrumentalism. Accordingly, the use of nature is limited “by widening the range of human ends, by prioritising these ends, and by admitting that promoting non-resource use involves curtailing resource use of nature” (Lee 1993: 335). While the treatment of nature as pure resource by genetic engineering might place it in the category of strong instrumentalism, conventional domestication does not necessarily fall under the category of weak instrumentalism, as it did not so much recognise non-resource use as allow it by default. The strong instrumental anthropocentric point of view, which was heavily criticised for being at the core of environmentally destructive activities since the origins of environmental ethics, is epitomised in the human (over) determination of the very form and function of nature *via* the technology of genetic engineering. This technology gives humans a greater degree of control over nature to the extent that it can be considered a tool of mastery (Kaku 1998). In biotechnology practice, nature is framed *only* as a means to a determined end. It is not deemed to have any other value. Yet, one cannot say with certainty that nature was seen to have other value under conventional domestication either. What one can say is that under conventional domestication there still remained biological barriers to the total enframing of

domesticated nature as pure resource, which have since proved penetrable at the molecular level.

Environmental virtue ethics

The idea that the problem of interfering with nature is not about breaching its established intrinsic value but is about the attitude of humans to nature more generally is central to the normative ethics of environmental virtue ethics. The revitalisation of the virtue ethics tradition in environmental ethics¹³⁴ recognises the familiar range of human vices and virtues in environmental actions¹³⁵. The concern is not whether nature is in possession of any particular moral standing, but whether a person's treatment of nature expresses or contravenes human virtue. Environmental virtue ethics is concerned with what kind of person one should be and what kind of attitude toward nature one should have. The virtues supposed to be at work in the environmental context include simplicity (Cafaro 1998), respect, prudence, wisdom (Shaw 1997), benevolence (Frasz 1993) and humility (Verhoog 2001; McKibben 2003; Sandler 2004). The most frequently recognised environmental vice is hubris – arrogance or excessive pride – when we believe and act as though we can entirely control nature and are right to do so. Other vices, such as gluttony, greed and apathy, also feature (Cafaro 2005). In virtue ethics, morality is derived from what contributes to human flourishing, which is in turn (often) derived from the species-specific being or *telos* of humanity (Kirkham 2006). Less teleological accounts of virtue ethics derive their notion of human flourishing from an environmentally sensitive account of what constitutes 'the good life' (Cafaro 1998) and, as with virtue ethics proper, though admittedly less so, by identifying and upholding a paradigmatic environmentally virtuous individual. The basic premise of environmental virtue ethics is that there exist certain dispositions to act that are better for humans and for nature, and these ought to be encouraged.

In environmental virtue ethics analyses of biotechnology, assessments of genetic engineering tend to focus on the qualities of humility and hubris. Interfering with nature by making it over to enhance its commercial usefulness is to exhibit hubris and, accordingly, to lack humility. In Kirkham's (2006) environmental virtue ethics interpretation of the public concerns about interfering with nature, which are summarised as concerns about 'vexing nature' and its religious version, 'playing God', to genetically engineer plants is to act

¹³⁴ Starting with Thomas Hill's 1983 article, 'Ideals of Human Excellence and Preserving the Natural Environment' and gaining momentum from Geoffrey Frasz's 1993 article, 'Environmental Virtue Ethics: a new direction for environmental ethics', onwards.

¹³⁵ There may indeed be new virtues that are specific to the environmental context, such as an aesthetic appreciation and gratitude for nature, or being 'rightly disposed to wonder and awe' (Hursthouse 2007).

contrary to virtue. The author's use of the expression 'vexing nature'¹³⁶ echoes Andrew Marvel's seventeenth century poem *The Mower Against Gardens*, which rejects artificial hybrids and grafting in its praise of nature: "And in the cherry he does Nature vex / To procreate without a sex" (in Kirkham 2006: 185). For Kirkham, this sentiment is an example of the history of disgust with the manipulation of nature that is also seen in Shakespeare's *The Winter's Tale*, when the princess Perdita describes cultivated flowers created through artificial breeding as "nature's bastards"¹³⁷. Kirkham argues that such concerns about the transgression of 'natural' boundaries are a comment on the environmental virtue of the transgressor, not on the existence of some fixed value of nature that ought to be protected. The nature that is 'vexed' is the transgressor's own internal nature. In a teleological account of human flourishing, this allows actions to be motivated by excessive pride, which is contrary to her better nature. Aside from Kirkham's lengthy article, most appeals to virtue ethics in the biotechnology literature are infrequent, usually incomplete, and "[tend] towards the rhetorical"¹³⁸ (Sandler 2004: 302). Sandler (2004) revisits Comstock's (2000) critical treatment of the hypothetical objection that to engage in biotechnology "is to exhibit arrogance, hubris and disaffection" in order to clarify the virtue ethics perspective. Comstock looks for signs of hubris in the individual performing the genetic engineering and does not find them, suggesting that the concern is that they might emerge in the future as a result of that person being desensitised over time and developing character weakness. Sandler rejects this 'slippery slope' view of virtue and reframes the problem as agricultural biotechnology being wrong "because to engage in it is contrary to virtue"¹³⁹ (p. 305).

Although environmental virtue ethics is ultimately concerned with people's relationship with nature, it is unclear where domestication itself fits into the account. According to Hull (2005: 106-107), an environmentally virtuous person would only allow the disturbance of wild nature after satisfactorily answering the questions: "[i]s the purpose of the development meeting an unavoidable, fundamental need, particularly one necessary for human flourishing? Can the end desired be brought about by any other means?". If we accept that

¹³⁶ The idea of 'vexing nature' is prominent in Francis Bacon's approach to comprehending the world by vexing, altering and disturbing nature through scientific study (Berman 1981). In the biotechnology context, the phrase 'vexing nature' is also prominently taken up in Gary Comstock's 2000 book, *Vexing Nature? On the ethical case against biotechnology*.

¹³⁷ Perdita's comment on this manipulation of nature: "Sir, the year growing ancient / Not yet on summer's death nor on the birth / Of trembling winter, the fairest flowers o' th' season / Are our carnations and streaked gillyvors / Which some call nature's bastards" is frequently noted in interpretations of the unnaturalness objection to genetic engineering (see Sagoff 2003; Daston 1998).

¹³⁸ To make this point, Sandler cites Rifkin (1993), McKibben (2003), as well as Comstock (2000). Comstock critically examines the virtue ethics case along with other intrinsic and extrinsic objections, but ultimately advocates qualified acceptance of agriculture biotechnology depending on the harm of its consequences.

¹³⁹ Along with McKibben (2003), Sandler identifies humility as the virtue that is violated by genetic engineering.

original and continued domestication *is* necessary for human flourishing, we are left only with a general directive that this disturbance is undertaken in the least intrusive manner possible. At face value, it is easy to claim that genetic engineering is more intrusive than conventional plant breeding, but without a clear definition of ‘intrusiveness’ this comparison offers only a relative scale that says nothing about the virtue of domestication in and of itself. That genetic engineering is admonished as a hubristic way of engaging with nature suggests, by inference, that there are ways of engaging with nature that would be humble and respectful. Beyond a general prescription for humility, a broad proscription of hubris, and the fact that virtue ethics has formulated a response to genetic engineering but not to domestication *per se*, this still does not provide much of a basis for an ethical appreciation of domestication. This is one of the problems for environmental virtue ethics more generally, as many different models of development and progress can be justified under the idea of human flourishing. However, perhaps the possibilities for an instructive virtue ethics conception of domestication are found in the places where it overlaps with other streams of eco-thought. For starters, its general appreciation and respect for nature that does not require proof of the existence of intrinsic value in nature provides other ways to shift the burden of proof from the protectors of nature to its despoilers (Norton 1995; *cf* Fox 1993). In this it concords with the ‘weak anthropocentrism’ of pragmatic approaches¹⁴⁰, which recognises that “humans could, for a variety of reasons, find value in nature for human-centred reasons which would not lead to a crude description of nature as a mere instrumental resource for human ends” (Light 2001: 11). Clarity is also found in expanding on the obvious commonalities between environmental virtue ethics and the literature that is concerned with elucidating an aesthetic appreciation of nature. Neither are concerned with establishing nature’s independent value, and both are concerned with encouraging non-instrumental but decidedly human-centred relationships with nature. Just as environmental virtues only become evident when exemplified in environmentally-related action, an aesthetic appreciation of agricultural nature, it is argued, is neither a passive or voyeuristic pleasure, but is also found in the doing. Brady’s (2006) aesthetic appreciation of agricultural landscapes is not the disinterested gaze of the country driver but the vested participation of bodily engagement. It comes from tactile, sensuous, immersion in nature. Further, the visual beauty of agricultural landscapes is only a side effect of its utilitarian design, while the ornamental garden is deliberately constructed. This ideal of the agricultural aesthetic is

¹⁴⁰ In an early article, Brian Norton’s (1984) ‘weak anthropocentrism’ thesis is that exclusively human interests could be wide and long-ranging enough to ensure the stability of the resource base and so constitute the basis of an environmental ethic.

clearly derived from the hands-in-soil experience of gardening, not from the highly mechanised factory-style mode of production that is modern agriculture.

The significance of this account of aesthetic appreciation for virtue ethics is, nonetheless, twofold. The first is that both aesthetic and virtue ethics speak of being in a relationship with nature that generates positive value. Environmental virtues and agricultural aesthetics are enacted, not observed, in the form and attitude of the engagement with nature. Unlike the aesthetic appreciation of wild nature, which sees us affected by but not affecting fragile ecosystems, the agricultural aesthetic needs us involved and invested. Farming is positively valued because it “enable[s] a relationship to the environment that can deepen our ties to it” (Brady 2006:18). Further, a turn to embeddedness and embodiment (and away from measured arguments about moral standing and moral considerability) necessarily makes links between the positive value of agrarian engagement with nature and the politics of who carries out the work of breeding and farming. This kind of labour analysis is strongly taken up in ecofeminist literature (see Mies & Shiva 1993; Salleh 1997; Mies & Bennholdt-Thomsen 1999).

Secondly, virtue ethics is concerned with emulating ideals of human virtue, and for environmental virtue ethics this means finding and holding up “inspiring accounts of people living well in nature” (Cafaro 2001b: 16). Brady’s identification of gardening as the ideal for the agricultural aesthetic identifies a particular kind of farmer as environmentally virtuous, and she explicitly acknowledges that the agriculture aesthetic is strongest in traditional, small scale agriculture. Knowledge about the damaging environmental effects of agriculture diminishes the aesthetic appeal of its landscape. Agricultural ethicist Paul Thompson (2003b) proposes that the ideal farmer is environmentally sensitive in the sense that she works ‘with the grain’ of the natural materials and processes of agriculture¹⁴¹. Again, ecofeminist scholarship on agricultural labours is instructive here in terms of advocating an ideal mode of agriculture on philosophical and political grounds. Subsistence agriculture is conceptualised as a farming livelihood in which crops produced on small acreages with few external inputs are primarily for family and local community consumption. In the ‘subsistence perspective’ provided by this livelihood, agrarian practice is oriented toward meeting real human needs, not the contrived needs of the market (Mies & Bennholdt-Thomsen 1999). The subsistence perspective offers a reconceptualisation of ‘the good life’ as local self-sufficiency achieved through meaningful and diverse agricultural

¹⁴¹ This was presented in more detail in Chapter One (pp. 35-37) on the divergent meanings of agricultural sustainability for the acceptability of biotechnology.

labours, rather than as the accumulation of material commodities through the spoils of wage labour.

Maria Mies and Vandana Shiva (1993) describe this life-oriented subsistence approach as 'freedom within necessity', and contrast it with the 'freedom from necessity' that is promised by the reduction of the agricultural labour force¹⁴², and the use of chemical, mechanical and genetic inputs in monocultural production models. 'Freedom from necessity' is typically sought through technological fixes, and is the underlying logic of the high-end efficiencies of biotechnology. The wide adoption of genetically engineered seeds consolidates the monocultural, machinery intensive, modes of agriculture for which they are designed into the future. In smaller scale, polycultural, labour intensive agriculture where the farmer can exemplify environmental virtue through meaningful agrarian engagement, genetic engineering is neither necessary nor desired. Environmental virtues of respect and humility are exercised by working within the boundaries and limitations of nature, and meeting the ecological imperative to preserve the agricultural resource base, which is central to more broadly ecocentric and alternative agricultural approaches (see Merrill 1976; Kamenatzky & Maybury 1989; Beus & Dunlap 1990; Gliessman 1990), and are a key element of the kinds of farmer organisations that advocate these approaches and enact an ecofeminist subsistence stance¹⁴³.

Ecofeminist arguments for the value of particular practices of farming are made within a comprehensive political approach that offers much more than the ambiguous concept of human flourishing. On the face of it, virtue ethics offers little of anything specific to the task of understanding the value of domestication and domesticated nature, but this could be deepened through synthesis of its approach with compatible aesthetic, pragmatic and ecofeminist perspectives. These possibilities are revisited in Chapter Seven.

¹⁴² The goal of freeing a large portion of the population from agricultural labours is recognised in ecofeminist critique as a 'barrier of disgust' for the subsistence work that is worldwide mostly performed by women (Mies & Bennholdt-Thomsen 1999). The barrier of disgust rests on the logic of progress that "historical action is necessarily Progressive and activities grounded in nature necessarily Regressive" (Salleh 1997: 95).

¹⁴³ Ecofeminism is both a politics and philosophy in that its critique of capitalist economy is an outgrowth of global women's and farmer's activism (Salleh 1997). For instance, the international *La Via Campesina* (the campesino [farmer's] way) that was formed in 1993 "to develop solidarity and unity among small farmer organizations in order to promote gender parity and social justice in fair economic relations; the preservation of land, water, seeds and other natural resources; food sovereignty; sustainable agricultural production based on small and medium-sized producers" (La Via Campesina 2008), and the *Nayakrishi Andolon* (New Agriculture Movement), a Bangladeshi principle-based farming organic that promotes self sufficiency and rejects dependence on chemical inputs. These organisations recognise the gendered nature of the agricultural division of labour, and defend the capacity to subsist as it stands outside commodity production and is threatened by the global agrarian market (Mies & Bennholdt-Thomsen 1999).

Reconciling intrinsic value with instrumental use

The traditional view is that intrinsic value and instrumental use have to be kept separate. Intrinsic value theory, as developed for wild nature, held within it the obligation for humans to leave wild places and creatures alone as far as possible. It is simply impractical that this general proscription of interference be transferred to domesticated nature. Yet this does not have to mean that the nature we use instrumentally cannot also be held to have intrinsic value, just that the obligations that arise from recognising that value are not prohibitive. The task of recognising intrinsic value in domesticated organisms, and detailing the resulting moral obligations, has been undertaken by Balzer, Rippe and Schaber (2000) in the Swiss government commissioned study reviewed below.

Biocentric intrinsic value and biotechnology

In keeping with the sympathy of European governments to public concerns in the genetic engineering controversy, the Swiss Constitution was amended in 1992 in response to the philosophical and welfare concerns raised in public debates. Article 120 of the updated Swiss Constitution declares that the scope and character of genetic engineering technology shall 'take into account the dignity of creation'. What this means in a practical sense, and where this fits within existing ethical theory, is the focus of the so-called 'Swiss expert report' (Balzer *et al.* 2000) that was commissioned by the Swiss government to interpret the amendment. The expert report considered the 'dignity' of nonhuman organisms to be derivative of their intrinsic value. This value is made distinct from the authors' conception of the dignity of humans, which is linked to a capacity to be humiliated, and a concomitant right to freedom from humiliation¹⁴⁴. As nonhuman organisms have no corresponding subjective experience of shame, their dignity is instead linked to their capacity to have a state of well-being that can be objectively measured and intrinsically valued. The concept of dignity still has moral implications as to how the holder of dignity should be treated by others. By affirming the dignity of nonhuman organisms, humans are obliged to show respect to living entities in their interactions with them, and by basing this dignity on the intrinsic value of the organism, the respect to be shown should be enacted for the sake of the organism, not for the value that the organism has for humans. Thus, the authors argue that "it is wrong to fell an apple tree [not] because it is held to be aesthetically valuable by human beings, or even because we can eat the fruits. The tree should not be cut down for its

¹⁴⁴ This argument is heavily critiqued by Jaber (2000), who points out that dignity accorded to creatures could also accommodate humans with respect to their capacities and ends and achieve the same outcome that Balzer *et al.*'s separate treatment of human dignity does. Further, Jaber argues that the recognition of human dignity should not be regarded as a right but as the basis upon which a catalogue of human rights are founded.

own sake” (p. 15). Dignity *qua* intrinsic value has a morally obligating character that not only directs humans to show respect to living entities, but to do so in ways that address, and are affirmative of, the intrinsic value of the organism.

The expert report approaches the task of interpreting the Constitutional amendment in two ways. First, it iterates a theoretical basis for the intrinsic value of life, within which humans are morally obligated to maintain the well-being of nonhuman organisms. This conception of intrinsic value is directly derived from Paul Taylor’s (1986) biocentric intrinsic value theory. Once the intrinsic value of all life is established, a secondary schema is introduced to set the scope of human obligation toward it. This is adapted from Attfield (1995) and allows for a weighting of interests through a hierarchical ordering of organisms, in which some life forms are judged to be more intrinsically valuable than others. There are, however, incongruities between these two approaches that affect the plausibility of the overall analysis.

Following Taylor, the expert report offers three interdependent reasons for according a living entity intrinsic value. First and foremost, a nonhuman organism is considered to have a ‘good’ of its own. Although the existence of subjective well-being in some living entities, such as plants, may not be in evidence, these entities can still have better or worse conditions. It is good for a plant to be watered, and bad for it to be wilting. Organisms have biological needs that are better met, and biological functions that are better unhindered. This is contrasted with non-living entities, where “it does not make sense to say that it would be bad for a stone to be broken” (Balzer *et al.* 2000: 16). It is argued that the ‘good’ of an organism is determined by its possession of the functions and abilities that members of its species as a rule can practice. Second, the organism has its own ends, and pursues these in striving to survive, flourish and procreate. “Each living being ‘struggles’ to keep itself alive, and ‘tries’, in its own unique way, to protect its own interests, to increase its well-being, to reach its goals, or to fulfil its purpose” (Balzer *et al.* 2000: 16). The individual goals of each organism relate to their particular biophysical structure and workings. The third criterion for according intrinsic value to nonhuman organisms is concerned with their level of biological organisation. The organism as an individual entity is significantly different from parts of organisms, such as organs, that may strive to maintain themselves, but have no good of their own outside of the good of the organism. Only natural goods and functions present in an individual as an organic unity can have intrinsic value.

This approach must, by design, accord an equal intrinsic value to all living organisms, from grass to insects to humans. The practical and regulatory implications of Taylor’s egalitarian approach face the persistent problem of reconciling the instrumental use of nature with its intrinsic value, and are considered to be ‘incompatible with considered intuitions’ (Rippe

2001:13). If it were to be adopted uncritically, “the consumption of plants would then be morally prohibited.” (Balzer *et al.* 2000: 18). An earlier report that was commissioned to clarify the meaning of the ‘dignity of creatures’ amendment¹⁴⁵ was rejected because it was too egalitarian and weighed the value of nonhuman organisms too heavily against human interests. It was considered to have gone ‘too far’ in only allowing an infringement of the dignity of creatures in circumstances where human survival was actually threatened (Rippe 2000). A solution was sought and found in the second report, which allowed for the greater weighting of human interests by adopting a non-egalitarian qualification of biocentrism, in which some living beings are recognised as more intrinsically valuable than others. Following Attfield (1995), this hierarchical ordering of inherent value in nature rests on the characteristics and qualities of the organisms’ individual ‘good’. The relative value is given to an organism by its intrinsic properties. Sentience and the social and organic complexity of higher animals accord them a greater intrinsic value than a vegetating blade of grass, as “if it is good to actualize potentials it must be better to actualize higher potentials and capacities” (Rippe 2000:14). This ranking system does not differ significantly from the ‘Great Chain of Being’ in that it inevitably privileges those capacities that are most similar to human characteristics. By applying Taylor’s biocentrism directly to domesticated plants and not withholding it from ‘biocultural’ organisms as he intended, the expert report accords domesticated organisms intrinsic value. Once the hierarchical qualifications are adopted, however, biocentrism does not do much to limit the scope and character of genetic engineering beyond what could be done by adopting an animal welfare perspective.

Aside from the question of whether vegetable interests even register in comparison to human and animal interests, the protection of the ‘dignity’ of domesticated plants within this schema depends on whether it can be said that the ‘functions and abilities that members of their species as a rule can practice’ are disrupted by genetic engineering. It is difficult to say with certainty that, for example, plants that grow faster than their non-engineered counterpart, or that are engineered to be resistant to herbicide, have had their normal functions impaired. The language of impaired function is better suited to discussions of animal, not plant bodies. The way that intrinsic value is reconciled with instrumental use by Balzer *et al.* does not allow for any meaningful moderation of the biotechnological use of non-sentient nature.

¹⁴⁵ The first report, which was commissioned to Praetorius & Saladin (1996) by the Swiss Federal Environmental Protection Agency though is not available in English, claimed that the dignity of humans and the dignity of creation were equivalent and that the interests of humans and nature were not able to be resolved in a utilitarian manner. By contrast, the second report by Balzer *et al.* (2000) specifically allowed for a pragmatic balancing of interests.

Intrinsic value and the wildness of domesticates

In a clarification of his biocentric holist position on domesticated nature, Holmes Rolston III (2002; see also Melin 2004) has provided direct commentary on the implications of agricultural biotechnology for the intrinsic value of nature. One might expect that the genetic engineering of living organisms would present something of a moral challenge to an author who locates the intrinsic value of organisms in their actual genetic material (Rolston 1999a). However, the reason that Rolston identifies genes as the holders of intrinsic value is because of the process through which particular genetic configurations come about: the evolutionary process of natural selection. It is through natural selection that organisms acquire an 'adaptive fit' with their environment. Rolston's schema subordinates the value of the individual organisms to the value of the species of which it is a member. It also maintains that the value of the organism is contingent on the integrity of its network of ecological relationships, or, on the value of the ecosystem of which it is a part. The adaptive fit of an organism to its ecosystem is argued to be constitutive of its integrity and intrinsic value, such that "[o]rganisms inherit value not only in their genes but from their competitors, enemies, and prey" (2002: 7). 'Adaptive fit' is thus presented in Rolston's statement on genetic engineering as a consequentialist standard against which biotechnological interventions in nature can be judged.

Clearly, assessing an intervention in nature according to whether it increases or decreases the adaptive fit of an organism to the natural ecosystem excludes all acts of domestication in the first instance. Although Rolston acknowledges that our growing and eating food is as necessary as other natural trophic systems and "cannot as such be either unecological or wrong" (2002: 8), he is unambiguous in asserting that "[t]he domesticated is the degraded" (2002: 9). Domesticated plants (or animals) are, by most definitions, far less able to survive in the wild without human assistance. This is the essence of their degradation. Biotechnologically produced domesticates are considered to be more environmentally safe if their capacity to survive in the wild is curtailed even further. Protecting wild areas against the spread of genetically engineered traits into wild populations is a key environmental concern, and one of the justifications for the anticipated introduction of 'terminator' technology. Improving adaptive fit to the natural ecosystem is a poor standard when the goal is to contain biotechnologically produced plants so that they do not become prolific. It is, by definition, incompatible with domestication. It seems that Rolston has either dead-ended his own argument, or has nothing in fact to say about the genetic engineering of domesticated nature. Indeed, the only instances where genetic engineering is permitted by Rolston is when it would increase the adaptive fit of wild organisms to their own environments, in cases where their ability to survive has been restricted by other factors. Rolston suggests

using biotechnology to engineer American chestnuts, using genetic material from Chinese chestnuts, to be resistant to the introduced fungus has that devastated the American species and in this regard is supportive of genetic engineering as a tool of conservation. This position stands in direct contradiction of Colwell's (1989) view that to genetically change wild species, intentionally or accidentally, is a degradation of their intrinsic value as this value is indeed derived from their autonomy.

Rolston's criterion of improving adaptive fit means that the original domestication of food plants represents more of a violation of their integrity than any modifications later brought about by genetic engineering. Domesticated plants are ill-suited to surviving in the wild because they have lost their seed dispersal mechanisms in adapting to the agricultural setting. Grain heads no longer shatter to disperse their seeds but remain fixed on the stalk for harvest. For Rolston, this loss of ecological fitness is the source of disvalue for domesticated nature. He argues that the domestication of corn so that its kernels remain tightly fixed to the ear represents a greater compromise than the genetic engineering for pest resistance traits. There is, however, some room to move in this schema, though not in a direction that provides any insights about genetic engineering necessarily. On Rolston's logic, those domesticates that have retained some of their ecological functions, such as canola, which is still known to shatter in the fields to cause a 25-50 percent annual crop loss, and soy and sesame, which similarly suffer from excessive shattering at maturity (Gepts 2004), have more integrity and intrinsic value than those that have not retained these functions. These recalcitrant domesticates are evidence of the wider fact that not all domesticated plants are fully domesticated in the sense of having lost their capacity to disperse their progeny. According to Rolston, the retention of this ecologically significant trait (when brought about by natural and not artificial selection) bestows value on the organism. In defending this position, Rolston intimates the existence of a continuum from wild to domesticated in which "[t]he nearer a domesticated plant or animal is to the wild type, the more likely crossing species barriers is to violate the integrity of the plant or animal" (2002: 10). Fully domesticated species simply have less integrity to violate, and what remaining integrity they do have is somewhat expendable. In an unequivocal affirmation of the value split between wild and domesticated nature, Rolston suggests the idea of an 'account of reparations', where the loss of natural value from biotechnological interventions that further the domestication of already domesticated nature are offset by a simultaneous commitment to "see that such integrity elsewhere remains in the wild" (2002: 10).

A more promising reading of Rolston's insistence that natural selection is the cause of value is possible, however. The concepts of 'adaptive fit' and 'integrity' can be recast in more

general terms as characteristics of 'wildness'. In principle, the physical capacity to survive in the wild ought not coexist with domestication, notwithstanding recalcitrant domesticates that retain this feature to varying degrees, but the concept of wildness is broad enough to encompass much more than reproductive and ecological fitness. There is a volume of material on the positive value of wildness *qua* otherness, which is typically related to the generic qualities of freedom and autonomy. On these, and other, grounds, the standard dualism of wildness/domestication is not as mutually exclusive as is readily assumed¹⁴⁶. The significance of Rolston's contribution to the biotechnology discourse is not so much in the detail of his schema, but in the idea he unwittingly presents that domesticated nature may have wild qualities and may be able to be valued for these qualities. Rather than following Rolston in regretting that domesticated nature is degraded to the extent that it is no longer wild; we can instead affirm that domesticated nature can be positively valued to the extent that it *is* wild. On the basis of this value, domesticated nature can then be defended against the further removal of its retained wildness. The recognition of retained wildness as a source of value may offer some way to provide both a positive account of domestication and a sound environmental ethics critique of biotechnology.

Return to the question of naturalness: species, telos and artefacts

A recurrent theme in popular and academic biotechnology debates is an expressed discomfort about the fact that most genetic engineering is transgenic, that is, it brings together genetic material from different species that would never have been able to procreate through sexual reproduction. Concerns about transgenicism are typically referred to as concerns about 'crossing species boundaries'¹⁴⁷, are strongly linked to the question of the naturalness of genetic engineering, and are often resolved by recourse to natural precedent. As prefigured in Chapter Two, there are three interrelated discussions that revolve around the question of species boundaries and the closely related idea of species integrity. The first is whether such a thing as a scientifically defined species exists. This discussion plays out as a tension between whether a lack of conceptual certainty about species necessarily spells their non-existence. The second, related, discussion is whether the natural changeability of species over evolutionary time legitimates their anthropogenic changeability over much shorter time periods. The third discussion takes us back to Rolston's conceptions of intrinsic value as residing in the unique genetic material of the

¹⁴⁶ See Chapter Six for a detailed treatment of this point.

¹⁴⁷ The popular and academic discourse surrounding the crossing of species barriers has been discussed previously in Chapter One (pp 11-12) and Chapter Two (pp 60-61).

organism and to wider questions of species identity, species integrity, and the revival of the Aristotelian idea of *telos* in environmental ethics and animal welfare literature. Discussions about species-being and *telos* are concerned with whether particular kinds of organisms have an ontological identity and whether changes to their genetic makeup and the functions they perform represents a change to this identity. An organism's *telos* is its "end, purpose ... ultimate object or aim"¹⁴⁸, its unique way of being, its species-specific goals towards which its physical and behavioural attributes are directed. Originally, the idea of *telos* was used by Aristotle as an explanatory concept for why biological forms always reproduced the same biological form, and why these forms developed in a particular way (Lennox 2000; Hauskeller 2005). In Aristotle's teleological philosophy of biology, natural kinds develop the way they do for the sake of their way of life. Contemporary understanding of evolutionary mechanisms exposes the scientific flaw in this essentialist logic, and the recent return of the *telos* concept is duly restricted to the context of the treatment of animals under modern intensive husbandry and discussion of the challenges represented by the biotechnological capacity to change species identities of individual organisms¹⁴⁹ (Rollin 1998).

A related discussion inevitably follows that of *telos* regarding whether the recognised goals, aims and purposes of domesticated organisms can reasonably be called their own, since they have been so extensively modified to meet human ends. Has the extent and intent of this modification turned domesticated organisms into living artefacts rather than natural entities? Determining the ontological identity of domesticates in comparison to their wild counterparts has implications for the natural value of domesticates and for the delineation of biotechnological from conventional domesticatory practice. A comprehensive consideration of this possible ontology is the subject of Chapter Five.

Crossing species boundaries: animals and plants

Concerns about crossing species boundaries by inserting genetic material from one species into another are commonly expressed in association with moral repugnance about the creation of hybrid, or monstrous, creatures. Notwithstanding the power of the Frankenstein metaphor as a symbol of consumer opposition to genetically engineered foods (Scott 2000), the popular vision of the monstrous hybrid is actually less significant in discussions about

¹⁴⁸ Definition from the Shorter Oxford English Dictionary Fifth Edition (2002) New York: Oxford University Press.

¹⁴⁹ The concept of *telos* was introduced into discussions about the extent of changes inflicted by domestication by Michael Fox (1990) to account for why it would be unethical to change an animal's way of being, irrespective of questions of welfare.

crossings between plants and plants, bacteria or animals, and more of a concern with regard to animal-animal mixtures. It is, however, a primary metaphor in debates about gene transfers between humans and animals, a revulsion about animals that carry human genetic material that is itself bolstered by literary associations with Dr Moreau's 'diabolical hybrids' (Heffernan 2003). These animals are usually 'red' biotechnological products, created for medical research and treatment purposes, including xenotransplantation, where animal-human hybrids may prove to be more successful sources of organs for transplant than animals. The monstrousness of human/animal species crossings has received the most attention in relation to moral issues of species integrity in the biotechnology ethical literature (see, for example, Chakrabarty [2003]). This focus is understandable, yet in these instances humans are often taken to be the only species with a fixed, real and defensible identity (see Robert & Baylis [2003]), and concern for the impact of crossing species on the essential identity of plants or animals is effectively disregarded. It is the strict boundary between humans and nature that is the one to be maintained, while the rest of nature can unproblematically be imagined and treated as an undifferentiated genetic resource¹⁵⁰ (Heffernan 2003). The treatment of the human/animal hybrid as the main transgenic object of concern by mainstream bioethics has thus been criticised for its structural exclusion of the perspectives of agricultural and environmental ethics on species crossings generally (Thompson 2003a).

Most critical comment on agricultural genetic engineering from environmental ethics quarters has related to animal biotechnology and the important issue of protecting animal welfare within the context of highly industrialised modes of animal husbandry. Impairment of the species-specific functions of animals is more easily identified than impairment of the same in plants, as is demonstrated by the difficulty of determining whether genetically engineered traits actually hinder plant life from 'performing those functions and abilities that its species as a rule can practice' under the Balzer *et al.* criterion¹⁵¹. Inquiries into animal biotechnology and its implications for species integrity do afford some insight into the nature of species identity more broadly, although the sentience-specificity of animal welfare approaches tends to reinforce the gulf between welfare and environmental ethics concerns. A vocal animal welfare position on genetic engineering has been presented by Bernard Rollin (1996, 1998, 2003) and his appeal to species integrity as the determinant of

¹⁵⁰ It is on this point that the hybridity discourses of science and technology studies and related areas is considered to differ from that of popular understandings of the concept: "[t]he biotech companies mobilise hybridity as if humans were safeguarded from it; hence nature is merely an instrument designed for 'our' disposal in the pursuit of immortality. Critical posthumanists recognise that this violent differentiation between human and nature paradoxically produces us as increasingly hybrid, as increasingly part of and produced by that other." (Heffernan 2003: 131).

¹⁵¹ As borrowed from Attfield (1995).

animal welfare considerations. Rollin employs the concept of *telos* as the particular nature of an animal that directs its needs and wants and is specific to the species to which it belongs, in his conceptualisation of animal welfare. Battery hens are frustrated by their enclosure in small cages because it renders them unable to fulfil their *telos*, their natural activities of nesting, pecking and dust-bathing, all of which are conducive to their species-specific flourishing. The *telos* of the animal defines the parameters of its well-being, so respecting the *telos* is the way of ensuring the animal's ongoing welfare. If our key obligation to domesticated animals is to minimise their suffering, then treating – or genetically modifying – animals so that their species-specific activities are interrupted is morally wrong because it causes pain and suffering.

Even though an animal's *telos* ought to be respected in any conventional or biotechnological modifications of its characteristics, Rollin argues that there is nothing wrong with changing that *telos* so that the animal's wants, needs, desires and animal welfare needs are changed, and its suffering is diminished. If animals can be biotechnologically modified so that they are no longer frustrated or pained by their conditions in the experimental laboratory or the intensive husbandry farm, then there is no longer cause for moral consideration on species integrity grounds. That is, we can change an animal's *telos*, but we cannot violate the interests that derive from their existing *telos*:

the reason we respect *telos*...is that interests comprising the *telos* are plausibly what matters most to the animals. If we alter the *telos* in such a way that different things matter to the animal, or in a way that is irrelevant to the animal, we have not violated [it] (Rollin 1998: 346).

On this basis there is nothing problematic from the viewpoint of Rollin's species integrity in developing a new kind of chicken whose well-being can be satisfied by laying eggs in the confines of a small cage. Rollin does accept that the creation of such animals could be undesirable on aesthetic grounds, but rejects the idea that it may be unacceptable on moral grounds¹⁵². It remains that "genetically manipulating animals to adapt them to housing systems which cause suffering, rather than changing the housing systems themselves, goes against the moral intuition of most people" (Verhoog 1992: 155), yet Rollin (1998) describes the original domestication of animals as having already changed the *telos* of animals to adapt them to housing systems. Rollin's use of the *telos* concept is limited to indicating a set of functional needs from which we can understand the nature of animal

¹⁵² After strongly refuting the moral substance of concerns about crossing species boundaries in favour of a purely utilitarian evaluation, Rollin (2003: 17) has recently conceded some ground. Although he maintains that concerns about species integrity are biologically ill-founded, he concedes that, "if taken seriously [a non-welfare conception of *telos*] should make us deepen our thinking regarding the adaptability of our moral categories to our ability to manipulate life".

welfare and he has been criticised for using a narrow, consequentialist application of the concept as a 'heuristic device' rather than using it to explicate any ontology about what is the nature of particular species of animals (Hauskeller 2005). Rollin maintains that any concept of species integrity that goes beyond animal welfare considerations to protect against modifications of *telos* that do not cause measurable harm is meaningless¹⁵³.

Other opponents of animal suffering in the biotechnological era support this emphasis on welfare over ideals of species integrity not only because of the primacy of welfare considerations but because of the perceived frailty of claims about the idea of species integrity in domesticates. An appeal to what Sandøe *et al.* (1996: 121) call 'genetic integrity' may be "in accordance with popular views, but does not stand up to critical reflection", and is summarily rejected, in line with Rollin, on the basis of the extent of genetic modification that has already taken place under domestication. It is argued that domestication and genetic engineering are so similar that "[t]he demand to respect the genetic integrity of animals...will, as a logical consequence, also tell against selective breeding" (Sandøe *et al.* 1996: 117). A critical assessment of in-principle objections to biotechnology (Burgess & Walsh 1998) notes both the history of domestication and the fact of evolution in arguing against any notion of species essence that is not itself changeable. Rollin also unites domestication and evolution in one rationale he provides for disregarding any moral implications for the crossing of species boundaries:

Species evolve; why then is it intrinsically wrong for humans to participate deliberately in that evolution, especially since we have been doing it since we evolved, unwittingly by serving as a selection pressure on other organisms and contrivedly by domestication and cultivation, preferential propagation, and the whole panoply of artificial selection (Rollin 1996: 537).

Evolution is frequently cited as proof that *telos* is an ill-conceived concept. Rollin dismisses non-welfare conceptualisations of *telos* partly on the basis that Aristotle mistakenly saw species (or 'forms') as being eternally fixed, entering the world fully formed and not

¹⁵³ In a non-welfare conception and axiology of *telos*, it is wrong to change an animal's *telos* because it is what makes that animal the particular, and valuable, entity that it is. In Aristotle's usage of *telos*, there was no part of an animal's physical being or behaviour that was not explainable with regard to its *telos*, its developmental goal (Hauskeller 2005). Thus, a chicken that is unable to nest because it is confined in a small space is not only suffering, but is no longer truly a chicken because it is no longer living according to its *telos*. An equivalent argument is made with regard the imprisonment of wild animals in zoos (see for example Dombrowski 2002; for a relational account of how the zoo transforms animals, see Acampora 1998). If short bursts of flying for chickens constitute a 'good' in the Taylorian biocentric sense of realising their *telos*, which resides in their whole physical and behavioural being, being hindered from flying is a 'bad'. Genetically engineering a bird to no longer have the behaviour to fly is also 'bad' because, although it reduces the suffering of being housed in a confined space, it denies to the bird a life that its whole body is directed toward (Hauskeller 2005). In effect, this modification 'kills' the bird as a distinctive, cohesive being, such that the end of animal suffering (given the same, or worse, animal husbandry techniques) is 'the end of animals' (Warkentin 2006).

changing over time. This is a common understanding of Aristotelian species but is, in part, a confusion of Aristotle's lack of particular knowledge about the world (evolution) with his positive commitment to the contrary explanation (some kind of typological essentialism). Aristotle had no reason to believe in evolution, and the question of whether he argued for the eternity of species *per se* is still a matter of debate amongst Aristotelian scholars¹⁵⁴ (Lennox 2000). Further, the concept of *telos* has been adapted from Aristotelian philosophy for contemporary contexts. It can still be a valid concept for understanding the world even if all aspects of the concept are not carried over. The question is, does the fact of evolution necessarily preclude any notion of a cohesive species identity? This question is only complicated by the fact that species themselves seem to resist categorisation more than would be popularly assumed.

Although species have traditionally been taken quite seriously as real natural units of evolution, and speciation is still a strong field of study for evolutionary biologists (Rundle *et al.* 2001), scientific uncertainty about the correct and comprehensive way to classify species is frequently cited as a reason to reject moral concerns about crossing species boundaries. The 'biological species concept' (BSC) is the standard classification¹⁵⁵, but it is defined by the reproductive isolation of organisms from different species, and only applies to sexually reproducing organisms. However, as most domesticated organisms are sexually reproducing and as it would be incorrect to mistake scientific contention about a concept as its rejection (Rundle *et al.* 2001), and, also, as the crossing of species boundaries is the only thing that ecocentrists acknowledge as differentiating conventional domestication from genetic engineering (Dobson 1995, 1997) and that evolutionary biologists acknowledge as differentiating domestication from evolution itself (Van Raamsdonk 1993), reproductive species boundaries do deserve consideration. Inter-species reproductive barriers include external factors, such as geographic and ecological isolation, temporal isolation where plants flower at different times of the day or year, and ethological isolation where plants have different insect pollinators. They may also be internally located, relating to the

¹⁵⁴ Lennox (2001) argues that the Aristotelian idea that form does not come to be and that reproduction is eternal are statements about the nature of reproduction as "a biological capacity for maintaining the form of reproducing agents", where "through reproduction the *individual* partakes in the eternal" (128). In this sense, argues Lennox, it is not the eternity of form that is of importance but the proposed relationship between form and the individual organism. An analogous contemporary observation is made by Dobson (1997) in his presentation of *telos* as a way to understanding the relationship between the individual and the species.

¹⁵⁵ The Biological Species Concept (first posited by Mayr 1942) is the most widely accepted species concept that defines species in terms of their reproductive discontinuity with other species: "[s]pecies are groups of interbreeding natural populations that are reproductively isolated from other such groups" (Mayr 1970: 86). An alternative is the evolutionary species concept advanced by Simpson (1961) and Wiley (1978), in which a species is defined as "a single lineage of ancestral descendant populations of organisms which maintains its identity from other such lineages and which has its own evolutionary tendencies and historical fate" (Wiley 1978: 18).

reproductive structure of plants. Some plants have self-fertilising flowers or can produce seeds that do not need fertilisation, some propagate vegetatively, while others' eggs and spores are not compatible. When species do cross-fertilise, the plant may abort the resulting seed, or it may be sterile or have poor ecological fitness so that it does not survive to reproduce (Van Raamsdonk 1993). Clearly, barriers between kingdoms are even more difficult to circumvent on all fronts¹⁵⁶. While it may be difficult to provide an infallible and universal definition of species, these barriers remain observable, ecologically real and significant, even though they do obviously shift over evolutionary time as speciation occurs¹⁵⁷.

Gary Comstock (1998) asserts that only a 'denial' of evolution¹⁵⁸ would allow someone to object to species crossings, but there are a number of problems with taking the fact of evolution as proof of the non-existence of *telos*. The first is that the observation that all things change, and indeed become extinct, is rendered relatively meaningless (with respect to the imperative of conservation) by the very long time frames of evolutionary change. The same rationale could justify the deliberate destruction of natural areas, or the anthropogenic extinction of any species. Species may only be "a momentary organisation of a certain chunk of information" (Shapiro 1989: 188-89), but that 'moment' is long enough to be significant. Species and species boundaries are temporally and phenomenologically meaningful to humans. To acknowledge the fragility, contingency and ultimate fluidity of the particularity of life forms is not to say that observable distinctions between these forms are not real or important. There ought to be some room between the position that there are inviolable barriers and that there are no barriers at all (Zwanziger 2003). On this point, I concur with Dobson (1995, 1997) that too much has been made about whether species scientifically exist, to the detriment of the issues at hand. The problem of finding a robust scientific definition is not necessarily a moral one (Streiffer 2003): looking at the world through Aristotelian eyes is a moral choice (Hauskeller 2005) rather than one that requires scientific endorsement. It may be that the difficulty of using *telos* as a conceptual tool is an effect of the reliance of environmental ethics on the natural sciences for its ontology that has also made it difficult to accommodate domesticated nature in its axiology.

Contra Rollin's rejection of the non-welfare implications of *telos* violation, Henk Verhoog (2001: 16) argues for a concept of integrity that is specific to "infringements of an animal's

¹⁵⁶ Notwithstanding the rare transfer of some genetic material between kingdoms with bacterial and viral vectors (Nielson *et al.* 1998).

¹⁵⁷ Aside from the artificially produced cross-genera cereal hybrid of wheat and rye 'Triticale', there are no known instances of speciation under domestication (Van Raamsdonk 1993).

¹⁵⁸ Together with the horizontal movement of genetic material between species that takes place in bacteria but is not yet known to happen between flowering plants (Van Raamsdonk 1993).

nature which go beyond health and well-being". The *telos* ought not be changed¹⁵⁹. According to Verhoog (2001, 1992), and Rolston (1988), the *telos* is where the intrinsic value of an organism resides. For Rolston, *telos* has a 'modern equivalent' – the genetic material of an organism – but, as discussed in the previous section, the intrinsic value of this material is qualitatively linked to the causal process of natural selection, and so is considered to be much diminished in domesticated species. Verhoog's concept of species integrity aims to include domesticates and instead rests on a life-regarding ethic derived, like the report from Balzer *et al.* (2000), from Taylor's biocentrism. Verhoog acknowledges that, from the ecocentric point of view, domestication entails "a degradation of the intrinsic value of the wild species" (1992: 159), but from his biocentric perspective he maintains that this degradation need not be total. The basis of his argument is that domestication is not a singular event, but takes place over time. The move from wild to domesticated can be mapped at each stage in terms of the domesticatory practices that permit advancement along the wild-domesticated scale. Verhoog proposes that the morality of different stages of domestication ought to be determined by the phenotypic distance that each stage creates between wild and domesticated states. He rejects the notion that there is 'no logical distinction'¹⁶⁰ between traditional breeding and genetic engineering and instead urges an examination of what biotechnology means "when we look upon domestication as a process, leading us further and further away from the natural state" (1992: 157). Thus "the relative distance between domesticated and wild animals may be used as a criterion for the evaluation of various stages in the process of domestication" (1992: 159). The yardstick against which Verhoog measures animal suffering (although his schema is theoretically equally applicable to plants and animals) is the wild state: "[f]or domestic animals the species-specific needs are those needs [that] the domestic animal still has in common with his wild relatives" (1992: 155). Again, although expressed more explicitly than Rolston (2002), we encounter a conceptualisation of domestication that allows for the retention of wild characteristics as a source of value. The retained 'wildness' of Verhoog's schema seems to relate to the phenotypic characteristics of organisms as well as their "independent existence and autonomous functioning" (1992: 152), though this is left open to further interpretation.

Discussions about the species identity, integrity and *telos* of domesticated plants and animals are ultimately discussions about what sorts of entities domesticates are. According

¹⁵⁹ Although it is testament to the primacy of the medical imperative in biotechnology that those who defend the existence of *telos* concede that important medical research is a reasonable justification for changing the *telos* of the experimental animal, even if it is immoral (for example, see Dobson [1997: 218] "the integrity of the sheep species is less morally weighty than the treatment of haemophiliacs").

¹⁶⁰ As was argued by Colwell (see p. 89).

to those who defend a non welfare-related version of *telos*, it is an inviolable source of the intrinsic value of the organism (Fox 1990; Verhoog 1992, 2001; Hauskeller 2005). Yet, across the range of positions reviewed in this section, the long term artificial selection of docile animals for their submission to herding and housing, and non-shattering plants for their amenability to easy harvesting, is considered to have already somewhat changed the *telos* of these organisms. If domestication has changed not only how these entities look and behave, but what they essentially are, then the question is: what kind of entities are they now? To what extent does the domesticated plant or animal still retain its own *telos*, under domestication, and under genetic engineering where, arguably, the ends for which they strive through their biological workings are no longer their own? If they are now striving for humanly determined ends, what does this mean for our relationship with these creatures? Bill McKibben (2003: 194-5) laments that such human creations strip us of our experience of awe and wonder¹⁶¹: “[w]hat will it mean to come across a rabbit in the woods after genetically engineered ‘rabbits’ are widespread? Why would we have any more reverence, or even affection, for such a rabbit that we would for a Coke bottle?”. Holland (1990: 172) suggests that the real impact of genetic engineering is the creation of a world “in which nothing ultimately remains which is untouched by human hand” and that “yielding to it, we risk sacrificing the refreshment of spirit and challenge which can only be enjoyed through contact with a natural world which is ‘other’, that is, given, not made”. These essentially aesthetic arguments about the diminution of the perceived and encountered world nonetheless rest on the question of whether domesticates and genetically engineered organisms are, indeed, human creations and sees a return to Eric Katz’s (1993, 1997, 2002) dualistic conception of the living artefactual object and the natural entity¹⁶².

Scholarship on the specific question of domestication and artefactuality has been predominantly undertaken by Keekok Lee (1999, 2003a, 2003b) in a series of publications that present a comprehensive Aristotelian framework for understanding the interplay between human intervention in nature, technology, and the creation of artefacts. On the issue of *telos*, Lee (1999: 191) maintains: “[w]hat is really wrong, morally speaking, is that the individual organism has been designed to suit our human ends and intentions rather than to pursue its own *telos*, its own projects, or ... its own trajectory. Its altered ontological status is the really worrying thing”. The primary question is whether the ontological status of domesticated plants has been altered so that they no longer qualify as natural entities and have, in fact, become biological artefacts. This particular turn to naturalness *via* the

¹⁶¹ Qualities recognised by Hursthouse (2007) to be uniquely environmental virtues (see p. 112 [fn 134]).

¹⁶² Introduced in Chapter Three (pp. 94-95).

natural/artefactual framework has implications for the inclusion of domesticated nature in environmental ethics value theories as nature, or even the expansion of environmental ethics parameters to incorporate living artefacts. The ontological identity of domesticated and genetically engineered nature is a considerable area of study, and will be properly examined in the following chapter.

Conclusion

This chapter provided a critical review of the contributions of environmental ethics to popular debates about biotechnology and how these revise or reiterate the traditional place of domesticated nature in environmental ethics. It was structured in three parts. The first looked briefly at the place of agriculture and the domesticated sphere in what are largely consequentialist assessments of biotechnology, in which the similarity between genetic engineering and domestication makes deontological ethical distinction difficult. Ecocentric value theories have been used to address straightforward environmental concerns about the ecological impact of genetically engineered crops on wild nature, with an emphasis on the integrity of ecosystems and the implications of Leopold's land ethic. These approaches tend to reinforce the low status of domesticated plants as exotic pollutants of wild natural areas, and effectively endorse genetic engineering where it can be shown that biotechnologically developed crops pose no greater threat to wild nature than conventional industrial agriculture.

The second section examined the ways in which environmental ethics has resolved the tension between recognising the value of nature and exploiting it for human ends. A common reason for the rejection of genetic engineering is that it not only makes instrumental use of nature but is seen to foster an excessively instrumental attitude toward nature. This position is also taken up in other forms *via* the framework of environmental virtue ethics and politically oriented ecofeminist perspectives. An instrumental relationship to nature is particularly problematic when that nature is also perceived to have value in and for itself. Acknowledging the intrinsic value of domesticated nature, and recognising that this value can be violated by genetic engineering, attempts to include domesticated nature within theories of value that were originally developed for wild nature. This task is subject to the pre-existing and well-recognised problem of reconciling the moral obligations of intrinsic value theory with the use and modification of nature, and prefigures the need for an appreciation of domestication as a relationship, and in relational not absolutist terms. This section reviewed the applications of intrinsic value theory to domesticated nature *via* an adaptation of Taylor's biocentrism to the domesticated context that informs a heavily qualified rejection of biotechnology, and Rolston's attribution of value at the species-level

that recognises intrinsic value in domesticates to the extent that they resemble their wild counterparts.

The third section identified a return to questions of naturalness *via* the ontological questions of species identity and artefactuality. It is not surprising, given the significance of sentientism for consequentialist ethics, that moral consideration of domesticated animals in light of the modifying capacities of genetic engineering has comprised a reasonable proportion of environmental ethics responses to the technology. These have typically focussed on the issue of species integrity as a moral obstacle to the production of transgenic animals for consumption. Despite the sentience-specificity of this focus, some of these inquiries also provide insights that are applicable to the case of vegetable life forms in a deontological defence of species boundaries. Much rests on the robustness of species concepts and whether species in fact exist. The use of evolutionary change as a standard against which to judge anthropogenic change, which is characteristic of popular biotechnological discourses, recurs here as a strong reliance on the necessary mutability of species in evolution as a legitimating argument for crossing species boundaries with biotechnology. In these species debates, 'naturalness' is taken to be the possession of a strong and constant identity. With regard to the ontological question of what kind of entities domesticates and biotechnologically produced plants are, 'naturalness' is contrasted with artefactuality and taken to be a property of a thing's history. The apprehension of genetic engineering and domestication through the natural/artefactual framework is a considerable area of scholarship and is set aside for further examination in the following chapter.

This chapter identifies three key areas of promise for the development of a positive account of domestication. The concepts of naturalness, wildness and relationship are separate, but interrelated, thematic areas in environmental ethics, which constitute the three remaining chapters of this thesis. This chapter has identified the nature/artefact distinction as a possible structure for understanding the ontological status of both domesticates and genetic engineering, and has introduced the possibility that domesticated nature possesses a retained wildness that is a source of its natural value. The instructiveness of the concepts of naturalness and wildness¹⁶³ for a comprehensive appreciation of biotechnology, domestication and domesticated nature is assessed in Chapter Five, *Naturalness: artefactuality and the ontology of domestication*, and Chapter Six, *Wildness: reconciling the wild/domesticated split*. The persistent question of whether genetic engineering and domestication are equivalently instrumental in their approach to nature is a question that

¹⁶³ Naturalness and wildness are the twin qualities against which the natural value of wild nature is typically judged in wilderness conservation debates (Ridder 2007; Aplet *et al.* 2000; Landres *et al.* 2000, Chapman 2006); they may similarly offer a way to ascertain natural value in the domesticated context.

ultimately concerns the quality of the relationship of domestication. Chapter Seven, *Relationship: toward a relational appreciation of domestication*, builds on the insights from examination of naturalness and wildness and presents a relational account of domestication.

Chapter Five

Naturalness, artefactuality and the ontology of domestication

Introduction

This chapter assesses the distinction between natural and artefactual objects for its instructiveness in understanding the ontological and moral status of domesticated nature, and distinguishing conventional from biotechnological interventions. It considers a range of criteria for determining artefactuality, including existing environmental philosophy scholarship on restored and domesticated nature, and contemporary interpretations of Aristotle's original basis for ordering worldly things as either natural or artefactual. It aims to ascertain the possibilities for the inclusion of domesticated nature within an environmental ethic through addressing the question of naturalness in the domesticated context.

In the natural/artefactual ontology, the natural is what has come into being independent of deliberate human design. While it might be affected by human activity and pollution, or be used by humans as an industrial resource, in itself nature is not an intentional human invention. Rather, it remains a serendipitous product of evolutionary or geological processes. An artefact, on the other hand, has come into existence through an intentional human plan to design, construct and bring it into being. Artefacts are typically thought of as buildings, paintings, a piece of furniture – human made objects that, although they may be made out of natural materials, are not natural objects. They are made from abiotic material that has never been alive, such as stone or mineral, or exbiotic material that was once alive but is now dead, such as fresh or fossilised timber. If domesticated plants and genetically engineered crops are to be understood as artefacts – and they have both been variously described and defended as such – then an artefact must also be able to be constructed from biotic material that is currently living, and this living artefact must have the same relevant characteristics as a non-living artefact in order for artefactuality not to be an empty concept.

The question of what makes a given entity, particularly a living entity, an artefact is not easily answered. There are many components to the broad definition of an artefact as an object that is intentionally designed and produced by humans. In some interpretations, the primary requirement is simply the conscious human intention to create the artefact. Even so, this requires consideration of the extent to which intention is present and affective, and the

grounds upon which it overrides the existing biological tendencies of the living entity to turn what was previously natural into something artefactual. In early domestication, which is causally linked to the transition from hunter-gathering to agriculture, the role of deliberate intention was strongly mediated by the ecological context of subsistence choices, and the unconscious selection of agronomically desirable traits. The continuation of plant evolution through domesticatory history was also not wholly a result of human design, but retained a significant element of unpredictability. Even where definitions of artefactuality only require that the individual existence of an artefact be ontologically dependent on the human intention to create and use it, the difficulty of determining whether this dependence holds for the individual artefact or is merely an instantiation of a kind works against the definitive categorisation of domesticates as artefactual, as does the persistent biological autonomy of domesticated plants. Biological autonomy in this context refers to the botanical qualities of plants and their capacity to reproduce themselves, both through their own growth and reproductive processes and through their evolution of other reproductive strategies more suited to the context of their domestication that sees their proliferation by breeders and farmers.

Contemporary readings of the Aristotelian basis for determining artefactual status return to his four causes of generation and motion: the material, the efficient, the formal and the final cause. While natural entities have all four causes given to them by nature, artefacts that are created according to external human design and technique have only their material cause as their own. It has been claimed that biotic entities can never be artefacts proper because their biological autonomy signifies their continued possession of all four causes, but attempts to discern the status of domesticated and genetically engineered plants argue for their differential possession of Aristotelian causes. This is traced to the vulnerability of the material cause to 'deep' technological intervention. Other criteria for determining artefactuality, such as the requirement that the act of creating an artefact is also an act of modification that gives the artefact new functions, can also account for the categorisation of domesticated nature as artefactual, but offer no way to differentiate products of conventional and biotechnological domestication.

Even allowing for degrees or gradations of artefactuality, the nature/artefact ontology is problematic in the domesticated context, and its axiological implications are too severe. The replacement of real nature with artefactual nature spells the loss of the valuable ontological category of autonomous nature. Thus, if domesticates are already regarded as artefacts then there is no way to include them in an environmental ethic, other than as a source of disvalue. If they are admitted as more natural than genetically engineered plants, then there is no further moral direction for the domesticatory relationship beyond the obligation not to

further increase their artefactuality. Other approaches to biotic artefactuality that emphasise the importance of the relationship and caution against the domination of nature through instrumental modes of producing artefacts provide more room to move. Recognition of the elements of biological autonomy in domesticated nature that resist its categorisation as artefactual leads to investigation of their retained wildness in the following chapter.

The domesticated food plant as an artefact

Domesticated food plants, particularly the world's major crops of wheat, rice and corn (maize), are routinely referred to as artefacts in the agricultural literature: "Domesticated plants are biological artefacts, each with its individual history and ... distinct cultural/biological lineages" (Wilson 1997: 1). Maize (*Zea mays*) is the most informative example as it has often been regarded as a "thoroughly cultural artefact" (Lind & Barham 2004: 47). Arguably the most domesticated of domesticates, the maize plant is unable to survive without human intervention. There is no longer any wild maize; aside from its small and distant relative teosinte, its progenitors are believed extinct. With its tight cob and inability to disperse its seeds, the ecological fitness of the maize plant outside the agricultural field is almost zero. As with many crop plants, maize also has a very strong social and economic presence. It has been highly significant for the political and cultural practices of traditional societies (Mann 2004), and through the tracts of commerce has played an influential role in shaping economies in the modern industrialised world (Warman 2003). The maize plant has indeed been instrumental in the development and continuation of important socio-cultural activities, and is a well and truly domesticated crop, but should this mean that it is necessarily an artefact?

For agricultural sociologist Lawrence Busch (1995b), the primary reason that the domesticated plant is an artefactual rather than natural entity is because its contemporary physical attributes are products of deliberate human selection. Over the history and prehistory of domestication, humans have been the force of evolution in the lives of their food plants, selecting seeds from the most favoured food plants for breeding or simple replanting. This human-directed evolution has led to the physical transformation of crop plants to plants with larger, tastier edible parts and reduced ecological fitness. Through the mechanism of artificial selection, the human intention to create more desirable food plants has been realised and, in this sense, the deliberate activities of humans in domesticating, and thus physically altering, food plants to be more to their liking has also turned these plants into artefacts.

Domesticated plants are ecologically dependent on humans and their very form is somewhat of a human achievement. They stand in contrast to wild plants, which have a morphology and life cycle that is biologically and ecologically determined, and subjected to change through natural evolutionary processes. However, if the domesticate is regarded as an artefact with respect to the human causes of their material qualities, their incorporation into cultural processes, and their ecological dependence on human activities for their continuation, then domestication is simply being conflated with artefactuality. In categorising major domesticates as artefacts because of the mere fact of their being domesticated, the distinction between wildness and domestication is a distinction between the natural or artefactual character of organisms. But there is more than one difficulty with this translation. Both the natural and artefactual realms include non-living entities that are not, and could not be, subject to domestication. Natural rocks and ecosystems, and artefactual statues and furniture, have never nor will ever undergo the process of domestication, even though they have previously and no doubt will continue to be used by humans in various ways. Although there is not a two-way correlation between artefactuality and domestication, this does not mean that there is not something particular to the process of domestication that grants its composite entities automatic status as artefacts. Artefactual objects may not have undergone a process of coming into being that mirrors the process of domestication, but domesticates may have undergone a process of coming into being that can be regarded as equivalent to the genesis of all other artefacts.

Domestication has not been a single or straightforward affair. It has been a very long process that has had distinct developmental phases – the latest being biotechnological – since its beginnings in Neolithic prehistory. These phases are, for the most part, defined by the power that the experiential and scientific knowledge of their periods has given humans of that era to effect more targeted and controlled change in their domesticates (Busch 1991; Pistorius & van Wijk 1999). The incidental domestication of wild food plants, the mass selection of desirable plants over agricultural history, the trial and error of plant breeding pre-Mendel's laws, the methodological approach of scientific breeding programs underwritten by knowledge of Mendelian genetics, and the employment of molecular genetics in the engineering of contemporary biotechnological food plants are technological developments and domesticatory methods that have afforded a greater and greater level of human control over the form and function of the resulting biotic product (see Chapter Two). If the simple fact of the agricultural plant's domestication is enough to secure its status as an artefact, then the Mendelian hybrid or the transgenic crop is no more or less artefactual, hence no more or less unnatural, than its predecessors. If this is the case, there must be a common thread to all the agricultural practices of the long and continuing process of

domestication, and this common thread must, in a core sense, approximate the method by which other exbiotic and abiotic artefacts are created.

In Eric Katz's (1993, 1997, 2002) theorisation of artefactual nature – undertaken within an assessment of the value of restored natural areas – the basis of a living organism's qualification as an artefact is the role that human intention plays in its coming into being. This criterion appears to support Busch's contention that it is the human intention that underlies the changes that crop plants undergo through domestication that makes them artefacts. Indeed, most accounts of artefactuality define an artefact as the result of intended human creation and give primacy to the intention element. But for Katz's artefact, it is not only important that the initial intervening activity is carried out by humans, it must also be done so for exclusively human purposes – artefacts are not only products of a deliberate human practice, but are products of a deliberate human-centred practice. Artefacts are objects that are “designed by humans for humans to satisfy human interests and needs” (Katz 1997: 98). It would be hard to argue that domestication – in all its phases – was not undertaken within the unmistakably human-centred project of procuring food, and Katz has explicitly identified both domesticated and genetically engineered organisms as artefacts on this basis.

According to Katz's formulation, there are two characteristics that distinguish the domesticate *qua* artefact from the wild biological organism. First, the very existence of domesticates is dependent on a deliberate human intention to bring them into being, that is, they can be said to have anthropogenic origins. Natural entities, on the other hand, have come into existence through evolutionary processes so their being in the world has come about independent of any human plan. Second, domesticates are not only designed, but are designed to serve the human ends of providing abundant and appetising food, that is, they can be said to have an anthropocentric function. Natural entities have no such function. The function element of artefacts has also been emphasised by environmental philosopher Andrew Brennan (1984) in his analysis of the natural and artefactual, which cited the essential functionlessness of natural entities not only as the reason why they are not artefacts, but as the reason why they have moral value. The question of the moral value of natural versus artefactual objects will be examined in a later chapter. For now, Katz's criteria can be summarised this way: artefacts have human origins and serve a human function, while natural entities have origins in evolution and inherently serve no human function.

Application of this fairly straightforward formula to domesticates supports the conclusion that domesticated food plants are, in fact, artefacts. In this regard, this formula also appears to offer no further basis for distinguishing conventional domesticates from genetically

engineered plants. Biotechnological products are also creations of deliberate human intention, and their manufacture is, without doubt, also directed to the fulfilment of human ends. Although it is argued that the benefits of biotechnology will be directed to the fulfilment of the ends of particular groups, and the needs of hungry farmers and health-conscious consumers will be unmet or even hindered, there appears to be little room for differentiation on this count. It is the direction of the artefact-making enterprise toward the ends of humans as a group, and not the relative distribution of its benefits within that group that is the criterion. But closer examination of the human origins element of artefacts may allow for some differentiation between the genetically and non-genetically engineered food plants on artefactual grounds. Katz maintains that the anthropogenic origins of artefacts cannot be merely accidental or inadvertent, otherwise any products of human activity – such as city pollution – could be classified as artefactual. The artefact must be the result of *deliberate* human intention. If, as Katz and others assert, the human intentionality factor is decisive in the classification of biological organisms as artefacts, then an important task lies in establishing the scope and level of this intentionality and its relative importance to the coming into being of the domesticated organism.

The role of the human intention in bringing into being, say, a wooden chair, is absolute; the chair simply would never have come into existence without the deliberate execution of the design into a material piece of furniture by a human agent. The same cannot necessarily be said of the early products of domestication.

Human intention in early domestication

A cursory examination of the literature on the evolution of domesticated food plants shows that the role of human intention in early agricultural development is far from certain. Theories of agricultural origins typically rely on the identification of either environment or culture as the primary causal factor (see Verhoeven 2004). The climate changes at the end of the Pleistocene epoch and the beginning of the Holocene (around 10 thousand years ago) that effected a rise in sea level and seasonal precipitation rates is often causally implicated. Climatic events have been theorised to have led to a concentration of people and domesticable plant and animal populations near water sources (Pumpelly 1908; Childe 1928, 1936), or combined with population increases so that rising sea levels and population pressure caused emigration and the transportation and cultivation of food grains in new areas (Binford 1968). Some models of agricultural origins stress the particular importance of seasonality (McCorriston & Hole 1991; Richerson *et al.* 2001) and population growth (Boserup 1965; Cohen 1977; MacNeish 1992); others emphasise the readiness of human cultures (Braidwood 1960; Wilson 1988) and techniques (Flannery 1969), the quality of

human inventiveness (Carter 1977), and the place of religious and ritualistic customs in the emergence of agricultural practices (Isaac 1970)¹⁶⁴. Where the origins of agriculture have been attributed to cultural factors, such theories either indirectly imply or openly assert that food plants were domesticated by humans as an intentional change to their methods of securing food. In addition to the role of intentionality in early agriculture is the further question of the difference between merely adopting a new mode of subsistence and deliberately creating domesticated plants with characteristics that are significantly different from their wild ancestors.

There are a number of factors that strongly mitigate a model of agricultural origins as exclusively culturally determined. Many archaeobotanists and other agricultural scholars have theorised that the domesticatory relationship between people and plants began as a distinctly ecological rather than cultural dynamic (Harlan 1970; Rindos 1984; Ladizinsky 1987; Fowler & Mooney 1990; Winterhalder & Goland 1997; Zohary 2004). These accounts emphasise the role that local and global environmental factors played in the shift from hunter-gathering to agricultural production, where “[t]he changes that we summarize under broad concepts such as domestication and the Neolithic revolution have their origin and form in the *ecologically situated* choices and actions of individuals” (Winterhalder & Goland 1997: 126, my emphasis). Katz makes it clear in his definition of artefacts that anything humans produce in their biological or evolutionary capacity – like eat, have children or make friendships – are not artefacts. These objects are natural by-products of natural activities, not intentional products of cultural ones. Hence the question of whether the emergence of early agriculture was revolutionary (cultural) or evolutionary (environmental) in character has genuine implications for the artefactual status of its products – domesticated plants.

The domesticated form of an organism “is the outcome of a selection process that leads to increased adaptation of plants and animals to cultivation or rearing and utilisation by humans” (Gepts 2004:2). What is still debated is how conscious or unconscious the onset of this selection process was. At the top end of environmentally deterministic models of agricultural origins is David Rindos’ (1980, 1984) thesis that the dynamics responsible for the origins of agriculture were not at all conscious but decidedly (co)evolutionary. Controversially, it explicitly rejects the need for any human intention at all in the development of agriculture (see Blumler & Byrne 1991). Rindos describes domestication as a slow evolutionary process where the biological barriers of potential domesticates were transgressed, and their characteristics progressively transformed by the shifting ecological

¹⁶⁴ See Verhouvern 2004 for a comparative assessment of most of these models.

functions of both humans and plants over time. In particular, the human intention element is diminished in the face of the absolute dependence of agricultural success on the biological characteristics of the early food plants that were suitable for domestication. According to Rindos, these proto-domesticates were weedy species adept at colonising the disturbed ground brought about by human activity¹⁶⁵. As annuals, these plants also had a high degree of genetic plasticity, meaning that they could respond to environmental selection pressures at the genetic level within a relatively short period of time. They were thus able to evolve early domesticated characteristics at sufficient pace with the ecological changes that were inadvertently brought about by humans' foraging behaviours. They were, in effect, domesticated before agriculture proper even began.

It has even been proposed that, before its establishment in specifically allocated fields, agriculture sprang somewhat serendipitously from the rich nutritional environment of latrines and garbage dumps where the seeds of favoured foods accumulated (Anderson 1952). By surviving digestion in the gut, or by simply being carried in its food form and then discarded, the seed organism was transported by people to new geographic locations. While this 'garbage dump' theory of agriculture has been extensively critiqued for, *inter alia*, only being applicable to some species and not accounting for all geographic sites of domestication (Blumler & Byrne 1991), what it and other coevolutionary theories highlight is the ecological dynamic of the animal-plant relationship, and the evolved purpose of the plant as a seeded organism. In early evolutionary history, aquatic and semiaquatic plants reproduced through lycopod sperm and egg interaction in the water. As life moved away from the water's edge to colonise the land beyond, plants developed the naked seed organism, such as that of conifers, that could drop from the tree and reproduce without such dependence on moist environments. The flowering plant, which evolved to spread its seed using both passive agents of transportation – such as the wind – and active agents – such as insects and animals – is the most recent evolutionary adaptation of plant reproduction to the surrounding biota (Swimme & Berry 1994; Kearns *et al.* 1998). In drawing a wide array of other organisms into its fertilisation and dispersal mechanisms, the flowering plant has established strong coevolutionary relationships with animals and, through domestication, humans. Thus, even where intentionality may explain the proximate cause of agricultural behaviours, their ultimate cause (as an obligate relationship) is able to be explained by evolutionary biology (O'Brien & Wilson 1988).

¹⁶⁵ Rindos' model of agricultural origins has attracted critical attention, and the weedy tendencies of primary domesticates in particular is strongly challenged (see p. 213 [fn 217]; Blumler & Byrne 1991; cf Bohrer 1991).

Plants' botanical characteristics were fundamental to their initial and ongoing attractiveness to humans, and their original capacity to be domesticated. Less than 3 percent of all flowering plants have been domesticated and only 0.4 percent of these became the major crops that feed the contemporary world (Hammer 2003). The size of this proportion is not due to any failure on the part of human effort, but to the intrinsic qualities of the plants themselves (Fowler & Mooney 1990; Diamond 2002). This fraction represents those plants that could be ecologically and biologically sustained in a domesticatory relationship. There are many edible wild plants simply not suited to domestication (Jones 1999), and some species more susceptible to domestication than others (Gepts 2004). The almond in its uncultivated state is a bitter, poisonous nut, and only the occasional mutation would have yielded an edible food. This mutation is governed by a single gene, and once discovered the resulting tree could be cultivated and the trait of non-bitterness passed on to future generations. Lima beans, watermelons and eggplants all have wild ancestors that were either bitter or poisonous, with the occasional sweet variety retaining its non-bitter quality and making its way into the fields (Rindos 1980; Fowler & Mooney 1990; Diamond 1998). The quality of bitterness in the nut of the oak tree, in contrast, is governed by many genes, and the occasional non-bitter acorn could not be reliably cultivated. Such biological barriers make up the distinction between organisms that are suited for domestication, and those that are not. For instance, if not for the zebra's good peripheral vision, and fairly vicious disposition, it may well have been lassoed into domestication alongside the otherwise physiologically comparable horse (Diamond 2002).

The timing of cultivation and domestication is an important controversy in the archaeobotanical literature (Blumler & Byrne 1991), and Harlan *et al.* (1973) have demonstrated, *contra* Rindos, that domestication of cereal plants could only have taken place after the move to cultivated fields. However, what is significant for the artefact/natural entity distinction is that the domesticated characteristics in question were not deliberately selected but evolved automatically. Whether it took place within the field or in the wild, early domestication was still a largely unconscious affair (Harlan 1970, 1973; Brookfield 2001; Verhoeven 2004; Zohary 2004). In grain crops, unconscious selection led to uniform times of seed ripening, increased size of edible parts, increased seed numbers, an upright habit, and the loss of camouflage colouring in seed coats. Some of these characteristics that underwent change in very early domestication were those with clear ecological functions which, once altered, made the plant more reliant on human beings for their survival than they were previously (Ladizinsky 1987; Fowler & Mooney 1990; Evans 1993; Smith 1995; Diamond 1998; Gepts 2004; Verhoeven 2004; Zohary 2004). Seed heads and pods will 'shatter' or 'pop' when the time is right to disperse the seeds in the wild. An occasional

genetic mutation would endow a plant with a non-shattering seed head or a non-popping seedpod. In the wild, these seeds would remain trapped in their encasements, and the plants would not reproduce but for the humans who gathered those seed heads or pods for food. Over time, humans exerted a significant yet unconscious selection pressure on these plants, and the non-shattering mutation became selected for, and proliferated in and around human communities, to finally form the gene pool of cereal and legume agriculture. The biological characteristic of having non-shattering seed heads was foundational to the early people-plant domesticatory relationship. It was, however, an unconscious ecological by-product of humans' harvesting activities.

The unconscious nature of the selection pressure that humans exerted over the early domesticates leads Rindos (1984) to argue that whatever intention people may have in early agriculture is irrelevant (irrespective of the impossibility of the task of finding out what that prehistoric intention would have been). Although the cause of this selection pressure was directly related to the wants and desires of people, these people featured in the pre-agricultural landscape as primarily ecological rather than cultural actors (Winterhalder & Goland 1997). In the coevolutionary model of agriculture, the role of deliberate human intention in early domestication is more on par with the role of human intention in the creation of a path that winds from, say, a village to its water source. Like the accidental development of proto-domesticatory characteristics in early agricultural fields, or possibly in frequently-harvested wild food stands, this footpath is not the result of a deliberate undertaking to clear vegetation and construct a thoroughfare. The intentional activity that led to its formation was the collection of water, which required frequent return trips to the river (Sperber 2007). Similarly, the intentional activity that led to the development of non-shattering seed heads was the collection of available food, and the inadvertent dispersal of the grain resulting in a proliferation of those particular plants. The path and the early domesticate may have been an effect of purposive human action, but they were not an artefact of it. Their creation remains largely unintentional.

Theories of agricultural origins in which agriculture came about through deliberate human decisions are also problematic in that they assume that the consequences of the agricultural lifestyle could be foreseen (Harlan 1995). The attribution of intentionality to pre-agriculturalists proposes either that they possessed a level of precognition, or that the practice of early agriculture returned a direct reward (Rindos 1984). Neither was the case. The transition to agriculture was initially physically detrimental, and was accompanied by times of great need as well as periods of starvation, and it is now well-recognised that the health of pre-agricultural people was superior to that of the early farmers (Harlan 1992). Most of the needs met by agriculture, such as the intensification of food supplies to feed

greater populations, only arose *after* its practice had been adopted (Diamond 1998). The long time frame of the development of domesticated characteristics in food plants also defies the model of agriculture as a food procurement system that gave immediate reward, and the biological characteristics of the wild progenitors of crop plants meant that the genetic changes that plants underwent *via* domestication may have been very gradual (Rindos 1984). Crop geneticist and conservationist Jack Harlan (1992:6) emphasises the role of long term ecological change in the development of agriculture and maintains that “[a]griculture is not the result of a happening. It is not due to an idea, a discovery, an invention, a revelation, nor even a goddess. It is the end product of a long period of adaptive co-evolution”. The scenario in which the move from hunter-gathering to agriculture was initiated by conscious choice and then pursued by forward thinking peoples is severely limited.

As discussed, there were also climatic preconditions to the emergence of the domesticatory relationship. At the time that agriculture was being practiced on any significant scale, the planet had only recently moved out of a long, dry, cold period characterised by abrupt temperature shifts and low levels of carbon dioxide; conditions that were generally inhospitable to the establishment of an agricultural ecology. The current temperate climatic pattern of dry summers and mild wet winters began about 12,000 years ago and was, in contrast, highly suitable for annual plant growth and food production¹⁶⁶ (Blumler & Byrne 1991; Richerson *et al.* 2001). There remains an essential human element to agricultural development and practice, but the dependence of this element on ecological, climatic and biological factors in pre- to early agricultural times was absolute. Thus, agricultural origins are not attributable to overwhelmingly cultural factors but are a mix of “ecological opportunity, human skill and interest, and a large random element” (Simmonds 1979: 12), making the easy categorisation of early domesticated plants as artefactual objects a problematic task.

Perhaps ambiguity about the role of human intentionality in domestication recedes once Rindos’ proposed pre-agricultural domestication phase is over, and primary and secondary domesticates¹⁶⁷ were farmed exclusively within the confines of the agricultural field. There, the deliberate selection and sowing of plants with desirable traits shaped the form of food plants and directed the trajectory of their evolution. Domestication throughout this time,

¹⁶⁶ Strong seasonal rainfall regimes during the Pleistocene/Holocene transition was a key factor that encouraged the growth of annuals and led to an increased emphasis on gathering wild cereals and pulses (Blumler & Byrne 1991).

¹⁶⁷ Primary domesticates are the ‘founder plants’ (Zohary 1989) which were the first farmed in each centre of origin where agriculture began. Secondary domesticates were domesticated later by people already practicing farming, and were often adapted from weeds growing in established agricultural fields (Blumler & Byrne 1991).

commonly referred to as a period of ‘mass selection’, was productively practiced by farmers and is generally understood to have been successful in yielding more desired results. Under mass selection, intentional human activities did affect the types and quantities of useful food plants in cultivation in ways that made them more useful to human purposes. On the face of it, this appears to attest to the primacy of human intention in domestication and justify the classification of contemporary crop plants as artefacts. But again, there were strong ecological and biological factors crucial to the domesticatory successes of this period.

To begin with, unconsciously wrought changes in plant characteristics in the presence of human activity continued during field agriculture. While seed germination times will differ in an open ecological system, and is an important evolutionary adaptation to environmental fluctuations in the wild, it is a characteristic that is detrimental in the agricultural field. There, harvest times need to be predictable, and other labours, such as weeding and irrigation, need to keep pace with expected crop growth rates. Those plants which occasionally mutated and produced seeds with uniform germination times were those selected for by early agriculturalists, simply by virtue of the single event of harvest. Over time, the trait for assorted germination times was simply not passed on. Without this adaptation, efforts to turn wild food plants into crops would not only have failed, they may never have been made.

Uniform germination times and non-shattering seed heads are just two traits of the ‘domestication syndrome’¹⁶⁸, that characterises domesticated plants, but these are nearly imperceptible to the farmer. Two obvious changes to the phenotype of the food plant, as selected for by gathering and then farming activities, were the move toward larger and tastier fruit. The mechanisms of such transformations are fairly self-evident – for their food gathering efforts it was more economical, and plain common sense, for humans to select the bigger and more delicious foods from the bush. Over time the edible parts of foods became larger, less bitter and generally more palatable, evolving so as to scarcely resemble their wild ancestors in this regard (Fowler & Mooney 1990; Diamond 1998). These transformations differ from the changes that occurred in the shattering, germination and reproductive traits of plants, because they were visible and recognisable to early farmers. Even though the actual means and nuances of inheritance were not known by these farmers, the fact of heredity was self-evident. Without any understanding of the mechanisms of heredity or reproductive biology, farmers were able to identify desired plant characteristics, and save and sow the seeds of those plants accordingly. The observation that such characteristics persisted into following generations gave farmers the ability to shape the

¹⁶⁸ Described originally in German as the *domestikationssyndrom* by Hammer (1984).

evolutionary course of food plants, according to the extent to which they satisfied purely human needs. Plants may have been selected for their size, taste or colour, or because they exhibited qualities of pest or drought resistance, were more easily harvested, fruited at particular times of the year, or had any number of properties that were beneficial for human cultural and agricultural purposes.

This improvement of seed stock was consciously pursued and maintained, however, a significant degree of premeditation was not crucial to its success. As with the problem of attributing intentionality to the Neolithic shift to an agricultural mode of subsistence, the generations of farmers who selected crop plants for their desirable characteristics were not in a position to foresee or foreplan the results of their practices. In *On the Origin of Species*, Charles Darwin (2004 [1859]: 42) noted that the food plants generated from this method of domestication were categorically not the product of deliberate design:

the art has been simple, and, as far as the final result is concerned, has been followed almost unconsciously. It has consisted in always cultivating the best known variety, sowing its seeds, and, when a slightly better variety chanced to appear, selecting it, and so onwards. But the gardeners of the classical period, who cultivated the best pears which they could procure, never thought what splendid food we should eat; though we owe our excellent fruit in some small degree, to their having naturally chosen and preserved the best varieties they could anywhere find.

Although the results of selecting desirable characteristics showed themselves quickly in each generation, the long term changes that farmers initiated in food plants under mass selection were gradually realised. The length of this process means that the results of mass selection are unable to be attributed to a single designing human agent. The same could be said of the Egyptian pyramids, constructed as they were over many life spans, but these are still doubtlessly artefacts. The difference is that the pyramids were built to a commonly agreed design, a blueprint that all worked to, and an endpoint that all worked toward. The human-directed evolution of domesticates could not have been undertaken to a specific design in the strict sense. Domestication was practiced by different cultures in different places, for different purposes and over very long periods of time. Importantly, the domesticates themselves were not simply inert material to be worked to the realisation of a predetermined plan, but living entities with their own life span trajectories and species-being tendencies.

The role of conscious human design in the period of mass selection was restricted in two significant ways. The first relates to the limitations of human influence in the face of the autonomous mechanism of evolution. The variety of plants in the field from which farmers

selected the most favourable types to save and propagate were there as a result of either random genetic mutation, or accidental hybridisation. In neo-Darwinian evolutionary theory, it is random mutation that serves as the source of variation that the environment selects the fittest from. These mutations no doubt played an important role in the generation of diversity from which the farmers could select, but the emergence of unexpected traits in domesticated plants was aided by having an 'outside' source of variation – wild organisms. Domestic populations farmed in proximity to either the wild progenitors of the agricultural plants or their relations were able to breed with them and become infused with their genetic material. Modern bread wheat, for example, was the welcome result of an unintentional hybridisation between a wild cereal (*Aegilops squarrose*) and the already domesticated emmer wheat (*Triticum dicoccum*) (Damania 1997; Gepts 2004), and the popular golden delicious apple variety was not deliberately bred but was discovered as chance seedling on a West Virginian farm (Fowler & Mooney 1990).

Although humans were able to direct the evolution of the field through mass selection, the plants themselves remained ecologically autonomous in their reproduction, and this autonomy proved crucial to the development of key domesticates. Darwin (2004: 98) maintained that "[man] (sic) can neither originate varieties, nor prevent their occurrence; he can only preserve and accumulate such as do occur". Unpredictable and indifferent to the needs or wants of the organism or its environment, arbitrary variation necessarily precludes deliberate design. The emergence of random genetic mutations and the hybridisation of domestic species with wild populations originated outside the realm of deliberate domesticatory practices, and took place independently of the human intention that is a necessary condition for the resulting plants to be considered artefacts.

The second and probably the most important limitation to the role of human intentionality is that plant evolution under mass selection did not entirely succumb to external control but retained a significant element of unpredictability. The heredity of characteristics may have been a self-evident process that farmers were able to exploit, but their knowledge of crop physiology and mechanisms of heritability remained limited. Simply selecting for plants with particular traits did not guarantee either the persistence of these traits into following generations or the elimination of coexistent undesirable traits. Contemporary domesticated species still shatter in the field, and characteristics that may have been desirable at one time may not have been needed or selected later on. The organisms of mass selection remained 'wild' enough to resist categorisation as products of the successful execution of human design. The attribution of human intentionality to the resultant form and function of domesticates is limited by the obdurate biological nature of the crop plants.

Darwin described the pre-scientific process of mass selection as ‘unconscious’ in contrast to the ‘conscious’, coordinated and methodological breeding programs of his century where the breeder sets about to “create some improvement already pictured in his mind” (1896: 214). The traditional description of human intervention in food plant domestication as either unconscious or conscious is not a definitive representation, however, and the terms themselves have not been uniformly applied through history. In the twentieth and twenty-first century in the West, the ‘unconscious’ label typically refers to the unintentional emergence of the domestication syndrome in crop plants as a process “more akin to natural selection but operating within a human-modified environment” (Leach 2003: 356) and a result of other human subsistence activities not undertaken with the express purpose of effecting changes in the plants. The term ‘conscious’ designates the deliberate selection of plant forms through purposeful seed saving, and all forms of similar interference that have come since. Darwin’s previous use of the terms equated human intentionality with the relative precision of the techniques of modification, which in turn depended upon the scope and accuracy of scientifically-acquired knowledge. Under this definition, the advent of professional, scientific, and now molecular plant breeding programs that seek to create particular pre-envisaged phenotypes must firmly establish the role of human intentionality in crop plant morphology. Following this assessment it would be difficult to withhold the status of artefacts from crop plants that result from these deliberate enterprises. Indeed, this logic is the essential condition to the controversial awarding of intellectual property rights over such organisms and parts of organisms¹⁶⁹.

Within Katz’s version of artefactuality, however, the knowledge and technique qualification adopted by the patents award system – and implied by Darwin’s distinction between unconscious and conscious domestication – is not necessary to the categorisation of biotic entities as artefacts. Katz developed his criteria to demonstrate that the restoration of a natural area through planting, landscaping and, as far as possible, recreating the previously existing ecosystem at a degraded site, is the creation of an artefact. In the case of the restored natural area, the forces that limit the role of human intentionality are even more pronounced than in the case of domestication. The species that are selected for inclusion in the restored area are unmodified and are fit and able to survive, reproduce and evolve on their own. The geographic area in which they are planted will be subject to cross-breeding with other plants external to the area. The area will be wild in all ways but its genesis. What is of importance to Katz is that the project of restoring the natural area is intended by

¹⁶⁹ Although only those rights granted as patents need the rights holder to meet the inventiveness criteria. Plant Variety Rights (PVR) do not have the same requirement as patents for an inventive step, which would tend to include only biotechnologically produced plants as inventions/artefacts (Jarvis 1993).

humans to serve human purposes, irrespective of the role that the wildness of its composite organisms will have in its continuing existence. By this standard, it would seem that the limits to the scope of purely human influence in early and pre-scientific domestication are immaterial to their categorisation as artefacts as long as the primary origins of crop plants are attributable to human endeavour. They would have become artefacts at least from the time they were deliberately planted in the field. Whether conscious or unconscious, the anthropocentric activity of securing food was the necessary condition of food plants' existence, and humans did intend to change its morphology to be more to their liking, even where their capacity to do so was limited. Following Katz, these anthropogenic origins makes domesticated plants ontologically dependent on human intentions, and so suffices to secure their artefactual status.

Katz's test of artefactuality has been criticised on a number of fronts. Although the qualification that intentional human activity must be directed toward the fulfilment of human purposes in order to produce an artefact certainly holds in the case of crop plants, it has been criticised for failing with respect to the actual objects of Katz's analysis (Lo 1999). Naturally restored areas may be created for reasons that do not satisfy exclusively human needs. They may be created for the sake of creating habitat for wild animals, or ensuring the ongoing existence of the native plant species themselves. By not consistently meeting the criterion of being created for an anthropocentric purpose, restored nature is not an artefact by Katz's own standard. Lo argues that this criterion is not only problematic in the case of restored nature: not all unproblematic artefacts are created for exclusively human purposes. A person may be moved to construct a shelter for a stray dog that likes to enter their garden. The kennel is undoubtedly an artefact, but it is arguable as to whether it serves a human purpose or is only concerned with housing the dog. Similarly, infrastructure is often constructed in national parks to protect wild animals from predation or competition. Such fences and gateways are not created with an anthropocentric focus in mind, but are designed and built out of a concern for wildlife. If biotic, exbiotic and abiotic artefacts are not always constructed for exclusively human purposes, the anthropocentric specification ceases to be a dependable condition of artefactuality, even if it is a relevant factor in the creation of restored natural areas.

Restored natural entities are also differentiated from domesticated plants in that they have no ongoing dependence on human beings for their continued survival. Thus, "successfully restored nature differs from wild nature only in the former's *initial* ontological dependence on human technology" (Lo 1999: 255). Further, this initial dependence is outweighed over time, as the ongoing survival and reproduction of naturally restored organisms becomes dependent on their own biological capacities and the ecosystemic workings of their

surrounds. As the restored natural area resumes its own evolutionary trajectory, its anthropogenic origins become irrelevant: “[i]n the wild, the natural processes of selection and evolution would, over time, subdue, if not totally eliminate, such a history in its progeny, reverting it to the status of being naturally-occurring entities” (Lee 1999: 97). Only their initial geographical location is determined by humans, and given that no living thing ever has control over where they are born, there is an asymmetry in granting this factor so much weight in the categorisation of otherwise unmodified and unbothered biological organisms as artefacts.

Criticisms of Katz’s criteria of artefactuality maintain that the biological and ecological capacities of the restored natural entities grants them a measure of independence from human design, and that this independence necessarily casts them as natural, not artefactual objects (Lo 1999; Bustos 2005). At least to some extent, this exemption should also hold for other biotic entities. These capacities are still present, although in a subjugated form, in the domesticated plant. Notwithstanding the role that proto-domestic evolution, wild hybridisation and the unpredictability of heredity may have played in limiting the extent of intentional human design in the consequent morphology of food plants, the very fact of being alive may afford the domesticate a level of biological autonomy that restricts or even precludes its artefactuality. Lo maintains that living organisms “differ from paradigm cases of artefacts, such as plastics, in their ultimate ontological dependence on their own biological and ecological capacities” (Lo 1999: 260). If this is the case then domesticated nature, including genetically engineered organisms, is equally precluded from being categorised as an artefact. Examinations of whether Katz was correct in casting restored biotic entities as artefacts necessarily raise the question of whether any living organism can properly be considered an artefact. It is with this question in mind that this chapter turns to the original Aristotelian conception of artefacts¹⁷⁰.

Aristotle’s artefacts

Aristotle described an ordering of worldly things as either natural or artefactual *via* four causes of generation and motion: the material, the efficient, the formal and the final cause (Lee 1999; Lennox 2001; Lee 2003a). All things have a *material* cause, that is, they are all made from some substance. In the case of a marble statue, the material cause is its stone material. In the case of a wild apple tree, the material cause is the seed organism. The *efficient* cause is the method by which a thing is made. The statue is carved with specialised

¹⁷⁰ Katz’s view has also been critically assessed for taking no account of Aristotle’s original formulation of artefacts and natural objects (Bustos 2005; Lee 1999).

tools by its maker, while the apple seed grows into a tree through the force of its own biological development. The *formal* cause is the plan from which a thing is constructed. The imaginary map in the carver's head, or a drawn-up blueprint spread out on the table, is the formal cause of the statue. Perhaps in the contemporary era, the formal cause of the tree would be identified as the interplay between its genetic code and its environmental circumstances, but, for Aristotle, the formal, efficient and final causes of the natural object were difficult to disentangle. The *final* cause of a thing is the purpose of its creation. The statue may, for example, have been commissioned by a town authority; the wild apple tree is driven into existence by its own purposes (Lee 2003a).

An artefact is given its efficient, formal and final causes by its human creator. Only its material cause – the stuff it is made of – is given to it by nature. An artefact differs from a natural thing because the causes of its generation and motion are not inherent, but are imposed from the outside. Natural entities strive to become themselves on their own in a way that artefacts do not. Where the form and functionality of natural things are generated by forces of nature, artefacts are given their shape and utility by their human designer (Lee 1999, 2003a). Aristotle's ontological distinction between artefacts and natural entities is more easily recognised in inanimate exbiotic or abiotic artefacts such as houses or pieces of furniture, which have a form and function that is clearly reflective of their designer's intentions. When it comes to biological objects, however, the clear identification of causal forces as either interior or exterior in origin is not so easy. A contemporary analysis of Aristotelian distinctions between artefact and natural objects in light of recent biotechnological developments (Schummer 2001) appears to do little more than lend support to Katz's emphasis on the primacy of human intention. The difficulty of trying to disentangle the Aristotelian causes of biotic entities is resolved as a matter of determining the degree of human intentionality in their design. In an example of a hedging plant whose height and location is specifically chosen to create shelter from the wind, "[a]s far as the hedge has been intended to become a windbreak, it is an artifact. As far as the hedge is a naturally grown plant, regardless of its place and human use, it is a natural thing" (2001: 7). The artefactual distinction is thus interpreted as determined by a perspectivism in which the biotic entity is only partially knowable and artefacts are more 'creations of the mind' (Thomasson 2006) than the result of observable forces at work. This perspectivism also holds for cultivated and genetically engineered plants, where they would be artefacts inasmuch as they are viewed as such. For instance, the genetically engineered plant is an artefact to the extent that it can be patented and traded as an invention. However, "[o]nce the genetic manipulation is finished, the plant with all its descendants have their moving and generating causes inside; thus we could consider them natural things according to Aristotle"

(Schummer 2001: 8). This ambiguity about the biotic entity's qualifications as an artefact leads Schummer to conclude that Aristotle's ontological distinctions, despite appearances, are unable to do the work of dividing the world cleanly into artefacts and natural things.

Other, more detailed, interpretations of Aristotle's division between the natural and the artefactual escape this conclusion and look specifically to the four causes as they coalesce within natural entities. In supplying their own material, efficient, final and formal causes, natural objects possess their own force of both generation and motion, and thus possess what Aristotle calls 'internality', or the internality principle. In order for a thing to be categorised as an artefact, it must lack any internal principle for either initiating change or maintaining stasis. This condition for artefactuality is appealed to in a refutation of Katz's living artefacts (Bustos 2005) within the argument that "no living thing (either plant or animal) can accurately be construed as artefactual" (Bustos 2005: 2) on Aristotelian grounds.

All living entities, by virtue of their biological capacities to develop, grow and reproduce, possess an internality principle. Although an exbiotic artefact can clearly change or remain the same without the intervention of its human creator, it only does so *via* its material cause – the matter that constitutes its form. Take the example of a timber bed frame. Over time it may deteriorate, rot, or even – depending on the circumstances of its neglect – revert to its botanical substance and send forth a shoot (Schummer 2001). But its material cause is the source of these changes. Neither the abstract design of the bed, the method of its carpentry, nor the human need that provided its reason for being internally causes these transformations. The bed might deteriorate because it was poorly designed, badly constructed, or worn out by extended use, but these changes to its state are externally, not internally, produced. On the other hand, we can "confidently attribute autonomy and spontaneity to plants and animals, taking it for granted that, left to their own devices, they naturally engage in all manner of changes, growing, moving about and so forth" (Wardy 2005: 71). A domesticated apple tree will lose and grow its leaves with the seasons, bud, flower, set fruit, and eventually wither and die. These changes will take place independent of whether humans have grafted the tree with a preferred fruiting type, harvested the apples reliably every year, or entirely abandoned their preference for the fruit in favour of a newly discovered variety. The apple tree is a biological organism that possesses an internal cause of change. It is, as environmental philosopher Paul Taylor (1986) argued, a 'teleological centre of life'. It has biological autonomy and the capacity to develop in accordance with its own *telos* and as an expression of its own 'apple tree-ness'. It possesses the internality that makes it one of Aristotle's natural objects.

In Aristotle's formulation of artefacts there are three further criteria that separate artefacts from natural entities (Bustos 2005), which in turn depend upon the condition of either possessing or lacking an internal principle for change. The most important of these is the keystone of most accounts of artefacts – the dependence of the artefact's very existence on the activities of a human inventor. In order for an object to be an artefact, it must be ontologically dependent upon another (natural) thing, that is, a human creator or artisan. This dependence cannot be simply incidental. The creation of the entity must have been the intended outcome of particular human activity. Ontological dependence is also the bedrock condition of Katz's formulation but, as was shown by Lo to be the case with restored natural areas, biological entities may not owe the entirety of their existence to the human creator. To test the suitability of attributing artefactuality to a living entity, Bustos (2005) offers an example of a mule. The individual existence of the mule – as with a restored natural entity – may be owed to human intention, but neither their whole species' existence, nor the specific kind of organism they are, is attributable as such. The question of interest here is whether the same can be said of domesticated plants.

People deliberately breed mules for use as work animals. What humans are not responsible for is the biological fact of mules being able to exist. Darwin (2004 [1859], 1868; also see Bartley 1992) heavily referenced domesticated plants as the exemplar of evolutionary theory because the changes they underwent under human selection pressure were so great as to mirror the natural evolution of the entire range of species and kingdoms of the biotic world. They also provided an effective demonstration of the mechanisms of how these changes could come about, that is, through the threefold process of variation, natural selection and transmission (heredity). Variation, as previously noted, is either generated by random genetic mutation, or results from reproduction with other phenotypically distinct, but otherwise sexually compatible, organisms. Bustos' mule would be an example of the latter, while the emergence of the variation in domesticated plants is accounted for by a combination of the two. As a result of naturally occurring variation, the mule defies categorisation as artefactual on ontological dependence grounds; its ontological dependence on humans is merely incidental, and only attributable on a case by case basis at the level of the individual organism. In this logic, however, the extent of an entity's ontological dependence on humans seems to be directly related to the likelihood that the specific kind of entity in question could come into being without human intervention through natural evolution. The large, sweet fruit, or non-shattering seed head of the domesticated plant could, as Rindos argued, have come into being through natural evolutionary processes, relying as it did on variation generated by random genetic mutations and reproduction

between compatible but distinct organisms, and selection by ecologically situated people. That such plants were ecologically successful as a result of human rather than natural selection may not be important because the variation from which they were selected was generated naturally. Of course, the same cannot be said for transgenic organisms, which are selected from technologically generated variation (Gepts 2002) that could not have evolved naturally. Thus, environmental philosopher Keekok Lee (2003a: 71) maintains: “[t]ransgenic organisms *ex hypothesi* cannot be naturally-occurring entities in the sense that they cannot be the results of natural evolution. They are the paradigmatic biotic artefact”.

Perhaps this distinction could support the popular protest that genetically engineered food plants are unnatural in that they are artefactual in a way that traditional domesticates are not. However, there is another dimension to a conception of ontological dependence that excludes the products of actual and potential natural evolution from being categorised as artefacts. This entails consideration of the specific kind of thing the living entity is. A mule has the capacity to come into existence naturally. It is not a new *kind* of thing therefore humans cannot be the chief cause of bringing it into being. If this logic is applied to the case of some uncontested abiotic or exbiotic artefact, such as a chair, the ontological dependence criterion would be satisfied because chairs, as a specific kind of thing, could never exist without deliberate human invention. Note that chairs satisfy this condition as a group of things – as an artefactual *kind*, not as an individual instantiation of that kind. Generally speaking, chairs were an original and novel invention. Since the time of their invention, further chair production has created new artefacts, but has not created new *kinds* of artefacts (Thomasson 2006). Just as intellectual property rights cannot be granted to pre-existing or common knowledge products or processes, a mule that has been deliberately bred is not a new artefactual kind, because mules already belong to the category of natural kinds. They belong to this category by virtue of either having already emerged, or having the capacity to emerge, through natural evolutionary processes. This interpretation of the ontological dependence criterion is similar in principle to the test for novelty that underpins the granting of patent protection over an invention, in which an entity can meet the condition of novelty if it could not theoretically have come into being through natural evolutionary processes (see Collins 1993; Ludlow 1999; Llewellyn 2000; Taliadores & Muratore 2000; Eisenberg 2002; Evans 2002).

Yet this attempt to unpack Bustos’ argument that natural entities should never be considered artefacts, although interesting, proves unproductive. One of its difficulties is that the above comparison of determining artefactual status to the conditions for awarding a patent is not just an analogy, but very closely approximates the test that an organism must pass if transgenic organisms are to be considered inventions in the sense of being a new kind of

thing. Although “the patenting of transgenic organisms recognises that paradigmatically they are biotic artefacts” (Lee 2003b: 73), an administrative refusal to grant a patent over an invention does not therefore mean that it is not an artefact. Of course, as a patentable invention must also be non-obvious to an expert working in the field and have a direct industrial utility; numerous applications for patents are rejected on grounds other than novelty (Montague 1993; Taliadores & Muratore 2000; Calvert 2004). But even if the ontological dependence condition for artefactuality is restricted to some variation of the patent novelty test, there are some genetically engineered products, such as those with herbicide resistance characteristics, that could have evolved naturally. In cases where characteristics have been isolated and removed from one plant, and incorporated into the genome of another plant with which it was sexually compatible, the resulting organism could have evolved naturally, yet is still eligible for patentability. Further, there is some argument as to whether genes can naturally transgress across species and kingdoms through viral and bacterial vectors (Nielsen *et al.* 1998); if so, transgenic organisms could not be classified as artefactual because of the in-principle, though extremely improbable, possibility that they could evolve naturally. The categorisation of genetically engineered organisms as artefacts – and traditionally and conventionally-bred domesticates as natural entities – on the grounds of evolutionary probabilities is not a sound argument in any case. Regardless of the impossibility of determining what kind of organisms may have naturally evolved on Earth given enough time, the condition for ontological dependence on human intention must have more resilience – and subtlety – if it is to be a meaningful criterion.

To this, Keekok Lee (1999) offers an elegant description of ontological dependence. Natural entities, both biotic and abiotic, have come into being independent of humans – through natural forces like earth formation events, weather patterns and natural evolution. Although they may be used by humans in various ways, in a fundamental sense they exist ‘by themselves’. All biotic entities also follow their own biological and species-specific trajectory. A plant “strives or ‘takes steps’ to ensure that its leaves grow in such a way as to be exposed to sunlight; to conserve moisture when the ambient temperature is too hot or too dry, by varying its rate of envirotranspiration; to get water at lower levels of the soil by sending its roots to tap a deeper source of moisture – all in order to maintain its own functioning integrity” (Lee 2003a: 15). A tree will grow from seed to sapling to tall woody plant, and eventually wilt and die. Importantly, this process takes place independent of the human use that is made of it. Thus, biotic entities also exist ‘for themselves’. However, a biotic artefact still exists ‘for itself’ but no longer exists ‘by itself’, in the sense that it does not actually come into existence through a purely natural process of evolution. It is ontologically dependent on its human creator.

Appeals to the normative value of evolutionary processes in determining artefactuality do not necessarily uphold a distinction between conventional and biotechnological domesticates, or even a distinction between domestication and evolution proper, on artefactuality grounds. Christopher Preston (2008) disagrees with the categorisation of either domesticates or genetically engineered plants as artefacts on the basis that they still remain embedded in evolutionary history. In both cases, “the genome on which the modification takes place is either the product of natural evolutionary processes or is the descendent of such a product” (p. 33). Under this criterion, the intact organism that is modified through an evolutionary process of selective change features as the ontologically important object. Genetically modified organisms are not especially problematic because they possess “a continuous causal chain between the genome currently being manipulated and the historical evolutionary process. At every point in this chain, there has existed a viable organism” (p. 34). Products of synthetic biology techniques, however, are able to be classified as artefactual because they have no evolutionary history as cohesive life forms. Generating living organisms by assembling molecular ‘bio-bricks’ with particular properties “is guided by the idea of leaving evolution and existing genomes behind in order to do a better job of creation with human goals in mind” (p. 33). Creating entirely new organisms this way differentiates synthetic biology from conventional and biotechnological domestication; it creates “a more fundamental type of biotic artefact” (p. 35).

One account of the ontological dependence condition that does rely on comparison to natural evolutionary processes is offered by philosopher Helena Siipi (2003), and is helpful for understanding why the mule might not be an artefact where domesticated plants are. As Bustos noted, individual mules that are brought into being by intentional human activity are the same kind of mules that may be born by happenstance. Although it is theoretically possible that domesticated plants could evolve naturally, this does remain unlikely. The selection pressure that brought them into being and continues to shape their evolution is distinctly human. Both the individual mule and the domesticated plant are intentionally brought into being, but the domesticated plant is changed in very particular ways by this process, whereas the mule is not. However, this assessment is unfairly asymmetrical – the mule cannot be selected and bred for particular characteristics because it is unable to reproduce its own kind, even though its horse and donkey parentage may be carefully chosen. On the other hand, the domesticated plant has been brought into being over long periods of time and evolution, and the resulting properties it possesses that its wild counterpart does not – such as larger sweeter edible parts, non-shattering seed heads, and uniform ripening times – then change the way that it is able to be used. It can be farmed within an agricultural field, it can yield more grain and fruit, it can supply abundant food to

an increasingly prosperous and prolific people. To account for this, Siipi (2003: 426) proposes a criteria that attributes artefactuality with respect to the specific *impact* that the intentional bringing into being has on the properties and functions of the artefact. This formula is twofold:

- (1) An entity *x* is an artefact only if *x* has been intentionally brought into existence by intentionally causing the coming artefact *x* to have certain properties. (2) An entity *x* is an artefact only if causing *x* to have certain properties has led *x* to have some new functions.

This double condition holds for both living and non-living artefacts. The building of a chair is inextricably entwined with causing that chair to have certain properties and functions; “[t]he intentional modification of the coming chair is how that chair is brought into existence” (Siipi 2003: 417), it is the same activity. Similarly, to domesticate a food plant is to intentionally modify its ‘raw material’ (the wild progenitor) so that it has certain properties (typical characteristics of domesticated plants) which give it new functions (new levels of accessibility and edibility). This formulation also accounts for the non-artefactual status of children. An artefact must be created and modified simultaneously, and bringing about a baby and ‘modifying’ that baby through particular parenting styles are two utterly separate activities.

Siipi’s criteria clarify the status of those biotic entities that human beings have had some intentional hand in creating, but which nonetheless remain natural entities. Biotic entities can only be artefacts if the deliberate human activities that bring them into being also give them particular properties, which in turn give them new functions. Deliberately planting a single sunflower in a field of naturally growing sunflowers does not turn either the flower or the field into an artefact. Similarly, *contra* Katz, restored natural areas are not artefactual. Although Siipi maintains that there is a strong relationship between being an artefact and having a humanly designed function, she shifts the focus away from deliberate design as the determining factor of an artefact’s ontological dependence on human intention.

If an observable creation of, or change in, an entity’s properties and functions allows for its categorisation as an artefact, then the unplanned long term effects of early domesticatory practices count as artefact creation. Aside from Rindos’ proposed proto-domesticates – whose creation was entirely unintentional – ur-domesticates and all subsequent domesticated plants are able to be categorised as artefacts. The relatively recent case of blueberry domestication is a good test for Siipi’s criteria, as it avoids the messiness of proto-domestic origins (notwithstanding the modification of wild blueberries through traditional fire-farming by indigenous North Americans [Bertelsen *et al.* 1995]). The domestication of the North American blueberry in the early twentieth century was a very deliberate activity

undertaken by a single human creator – botanist Frederick Vernon Coville (1888-1937)¹⁷¹. Although wild blueberry plants were transplanted into gardens in the late 1800s, they were not deliberately cross-bred until 1906, or hybridised until 1911 (Coville 1937; Bertelsen *et al.* 1995). The wild blueberry is smaller and more intensely flavoured than its cultivated counterpart and, as an open pollinator, exhibits wider range of variation. The wild blueberry bushes that continue to be intensely cultivated – with many now over 100 years old and managed only by strong pruning – remain otherwise unmodified as natural entities, while their domesticated relatives have become artefacts.

The goal of domesticating blueberries was to effect an increase in berry size, firmness and productivity, a reduction in scar size, a lightness of fruit colour, and a sweetness of berry to dessert quality (Moore 1965). Wild bushes were selected for these beneficial qualities, and Coville and others set about to deliberately create plants – through crossing and back-crossing – that exhibited these characteristics. As a result, the domesticated blueberry gained new functions: large berry size expedites harvesting, light colour retains berry freshness, small scars reduce moisture loss, and fruit firmness allows for better handling and shipping. Higher yields give more fruit, and vigorous hybrids can be grown in a greater variation of climates. The domesticated blueberry was intentionally brought into existence by causing it to have new properties, and these new properties caused it to have new functions. Thus it is, by Siipi's criteria, an artefact. However, there is nothing in this formulation to distinguish the turn-of-the-century breeding and hybridisation techniques resulting in prized blueberry cultivars from recent attempts to genetically engineer higher nutritional quality in the blueberry (Scalzo *et al.* 2005), or these techniques from those of mass selection. There remains little room in Siipi's version of artefactuality for degrees or gradations of artefactuality to differentiate between conventional domestication and genetic engineering.

Aristotelian conditions: low and high levels of unity

The next additional criterion of Aristotelian artefactuality presented by Bustos (2005) is that an artefact must possess a *low level of unity*. Unity is the coherence between the composite parts of an entity and its movements. Living organisms have strong functioning connections and communication between their parts – variously identified as organs, limbs, cells, and so on. Thus, they have a high level of unity. Bustos employs the example of a collection of sticks to demonstrate the concept of low and high levels of unity. A bundle of sticks tied together by a length of string has more unity than those same sticks do when simply piled on the ground. When the sticks are moved from one place to another the bundle can be

¹⁷¹ In collaboration with blueberry enthusiast, Elizabeth White.

relocated in one movement, but when they are a pile the move requires several trips. However, the singular movement of the bundle is due to an external condition – the encircling string – while the single movement of an organism is due to its internal condition of having strong coherence between its parts. A timber chair is only a step up from the collection of sticks, with glue and joints replacing the knotted twine. Like the bundle, it can be moved as one, and its low level of unity is concealed by the external materials that hold it together. If a tree is transplanted by the roots, its limbs, trunk, leaves and buds also travel with it. It has a high level of unity. Seemingly counter-intuitively, a forest has a relatively low level of unity. Although it is held in place by strong ecological inter-relationships between its parts, if its flora are moved some distance, its fauna will not necessarily follow.

It is both obvious and seemingly unremarkable that the biological organism has a high level of unity, and that genetically engineered or domesticated plants would be no different from wild or uncultivated flora in this regard. Of interest is the prospect of a differentiation to be made between them at a *conceptual* level of organic unity. Plants produced by genetic engineering are a literal patchwork of traits and corresponding genes: genes are snipped from one organism and inserted into another. The very large number of unsuccessful transfers resulting from the insertion of the new gene/s at the incorrect location along the chromosome (Adam 2000; Clark & Lehman 2001) remind us that the internal coherence of the genetically engineered plant is not to be taken for granted. The normalcy of this disunity is supported by the traditional reductionist view of the organism as the one-way expression of characteristics that are coded in its genes¹⁷².

Aristotelian conditions: reproduction

Bustos' third additional condition for Aristotelian artefactuality is that an artefactual entity must lack the ability to perpetuate itself or reproduce its own kind. On the face of it, most organisms, unless they are infertile or otherwise incapable of reproduction, would meet this criterion and, on these grounds, would not be considerable as artefacts. But there are a number of living entities that cannot reproduce themselves, even though they possess their own internal cause of change. Bustos' mule is a hybrid of horse and donkey that is infertile by nature and cannot perpetuate its own species¹⁷³. As a sterile hybrid it does not, strictly

¹⁷² There is considerable conflict between the fields of molecular genetics and developmental biology as to the respective roles of genes and environment in the development of the organism (see Chapter Two pp. 68-72). The reductionist representations of molecular genetics that have the effect of hiding the lower level of unity of the biotechnological organism are increasingly giving way to models that allow for gene-environment interplay (see for example Orphanides & Reinberg 2002).

¹⁷³ There are, though, verified cases of fertile mule mares (Rong *et al.* 1988).

speaking, even have a species to perpetuate. In crop agriculture, the hybrid maize that was bred in the 1930s *via* the double-crossing hybrid technique derived from Mendel's laws was not infertile but was certainly reproductively limited in that it did not 'breed true'. Perhaps a more accurate agricultural comparison to the sterile mule would be the as yet unreleased crop plants genetically engineered with a 'terminator' gene that renders them sterile, with the aim of protecting intellectual property rights and guaranteeing increased markets for seed in each growing season, whilst also containing possible genetic pollution.

If organisms such as these do not satisfy the reproduction condition, is this alone enough to secure their status as a humanly produced artefact, or is this shift still precluded by their possession of internality? Bustos argues that even if the mule – or, for that matter, the genetically engineered sterile crop – does not perpetuate its own species, it is still the *sort* of being that can perpetuate itself. As biological organisms, mules still take in nutrients to grow and reproduce their own bodies. While they may be limited in their capacity to enact all of their biological capacities, they are still biologically autonomous and therefore cannot be considered artefacts. Bustos accounts for the possibility that living entities may possess limited or no capacity to reproduce a next generation by reaffirming their fulfilment of the internality condition: they still have an internally generated capacity for change and stasis. His mule also fulfils the Aristotelian conditions of having a high level of unity and not being ontologically dependent on the artisan for its creation (while domesticate plants seem to fulfil only the former), but it is its possession of internality that is the trump card in Bustos' case against the existence of living artefacts. Internality is *the* necessary and sufficient condition for naturalness. Given that living entities continue to be described and treated as artefacts, and, that Aristotle himself was not definitive on the issue of biotic artefacts (Wardy 2005), the assumption of the primacy of internality over reproductive or any other criteria deserves further attention.

More radical interpretations of what reproduction might mean in the context of both non-living and living artefacts offer a way forward. The first of these is presented in Michael Losonsky's 'The Nature of Artefacts' (1990) – which is, incidentally, cited favourably by Katz – that rejects Aristotelian causes and principles on the grounds that they underestimate the power that artefacts have to effect their own change, including their own reproduction. Losonsky's main argument is that artefacts have an internal nature that persists irrespective of their human-given functions. He attempts to describe this nature through the example of a mechanical clock. In doing so, he makes an important observation about the human-artefact relationship; simply, just as humans manifest their need or desire for certain objects by creating them, these objects in turn exert a particular kind of creative force upon us. At the basic level, this reciprocity manifests in the dramatic changes to the social and economic

world that have been caused by the particular and precise manner in which the mechanical clock marked the passing of time. Technological changes in the clock's development toward greater precision can also be traced to features of the clock's own nature. For instance, using oscillations to mark time is part of the nature of the clock. But the swinging pendulum that gave the clock its repeating motion and allowed it to measure the 'continuous and non-repeating phenomenon' (Losonsky 1990: 86) of time was unsuited to at-sea conditions. The impact of this on navigation led to the replacement of the oscillating pendulum with the balance spring, thus enabling the accurate measurement of longitude. The clock was invented and its increasing usefulness in a clock-oriented world demanded its progressive refinement. Thus it can be said that the clock *qua* artefact demanded its own reproduction.

A clock or a chair is invented for a use, and once it is produced it encourages ongoing use: a chair 'invites' being sat upon. Importantly, "if the artefact invites use, and use eventually leads to its disintegration, and its disintegration causes a demand for another token of the same type, then the structure of the artefact also contributes to the reproduction of its kind" (Losonsky 1990: 84). Losonsky describes artefacts as having intrinsic and functional natures that are the causal force of their own further change. In this formulation, any and all prolific artefacts – biotic, exbiotic or abiotic – would satisfy the reproduction condition. Whether or not this description is convincing enough to challenge Aristotle's definition of artefacts as those entities lacking any non-material internal cause of change, it still has implications once transposed to the particular case of the non-reproducing domesticated. If abiotic and exbiotic artefacts are seen to initiate their own reproduction in light of the power of their original design and function to shape and generate human activities, biotic artefacts can do the same, *via* the particular biological processes that comprise their internality. This takes place through the evolution of other reproductive strategies more suited to the context of their domestication.

In an analysis of the role that the cultural and biological function of a biotic entity plays in determining its artefactual status, Dan Sperber (2007) presents the example of the non-sexually reproducing seedless grape. In Sperber's analysis, the functions of a particular entity are defined by what it does, in the sense that these functions are observed as the actual effects of that object. The fleshy fruits of wild plants attract birds and insects that perform pollinating and seed dispersal services, hence, the function (effect) of that fruit is to aid the reproduction of the plant. That this effect is unintentional is not relevant to the fact of its functionality; function is derived only from effect. The effect of an artefact, however, is intended. Therefore, abiotic and exbiotic humanly-designed objects can quite unproblematically be categorised according to their artefactual function, and 'wild' organisms in relation to their biological function.

Talk about products of evolution having functions in the same way that human tools and instruments have functions risks a false impression. The functions of unproblematic artefacts are, for the most part, intended, whereas the functions of characteristics that successfully contribute to the ongoing survival of particular life forms are emphatically not. The artefactual function (effect) is intended, whereas the biological function (effect) is not, but the biological function is nonetheless valuable to the organism that possesses it. In the case of domesticated plants, both (intended) human design and (unintended) natural selection contribute to their overall function. Humans intentionally seek to increase the size of domesticates' fruit by selective planting or breeding, while the domesticate unintentionally produces the kind of fruit that is most effective in fulfilling the function of that fruit, that is, which most effectively aids the plant's reproduction.

This co-incidence of functions requires the articulation of another layer of causality in the categorisation of living entities as artefacts. Function is the effect of an object or trait, and explains why the object or trait is the way it is. The function of an entity may have come about through intentional design, natural selection, or a mixture of both. Although an entity has a particular effect, simply describing this effect and labelling it as its 'function' does not necessarily explain why the entity continues to exist. It may appear self evident that, for example, chairs are popular because humans prefer not to squat on the floor. But a raw description of a chair's function as an object to sit upon at a comfortable distance from the ground only implies, but does not stipulate, this preference. Without an accompanying description of the benefits of sitting over squatting, there is no way to appreciate exactly why the invention of the chair has proliferated. For an explanation of why the object persists through time, that is, why it is either biologically and culturally reproduced, we must look to what Sperber terms its *teleofunction*.

In the context of evolution, the biological teleofunction lies in those phenotypical features of the organism – both material and behavioural – that contribute to its reproductive success. Teleofunctions within nature are those that support an entity's ongoing reproduction. Teleofunctions within human culture are those mechanisms through which artefacts, ideas and behaviours are propagated, namely, through mental representations and their visual production. To delineate biotic from other artefacts, Sperber employs the terms 'biological artefact' and 'cultural artefact'. An object becomes a cultural artefact proper when its cultural teleofunction and its artefactual function correspond. Sperber illustrates this point with his account of the suntan as a cultural artefact. The suntan is often sported by wealthy people and acquired in their leisure time, which, through the mechanism of mimicry as an expression of aspiration to ascend the socio-economic ladder, causes others to see the suntan as attractive. The tan is an artefact because it is an intended and desired effect of basking in

the sun. Its artefactual function is to make its holder appear a particular shade of brown, while its cultural teleofunction is the common representation of suntans as attractive. This positive representation is the means of its proliferation and reproduction.

Biotic entities that have biological and cultural artefactual functions also have corresponding biological and cultural teleofunctions. The biological function of the fruit of the domesticated plant is to disperse its seeds. The biological teleofunction is the provision of food for humans, because the effect of this arrangement is a greater reproductive success for the domesticated plant. To illustrate the inter-relationship between biological function and teleofunction in these ‘biological-cultural’ artefacts, Sperber reviews the seedless grape. If domesticated plants are unproblematically regarded as cultural artefacts in agronomic literature, then the seedless grape is the cultural artefact *par excellence*. In order to make the fresh and processed consumption of the grape more appealing, a grape plant that produced no seeds was relatively recently and deliberately developed (Perl *et al.* 2000). The seedless grape’s capacity for sexual reproduction has been completely paralysed¹⁷⁴. Accordingly, the biological function of the fruit of the plant – to attract and recruit animals to transport its seeds – is made redundant.

Sperber cautions against interpreting this loss as the triumph of culture over biology. Instead he describes the change in terms of the evolution of a new biological function – vegetative reproduction. People propagate the domesticated grape by grafting and striking cuttings. Unlike the variation produced by sexual reproduction, these methods produce a clone of the plant, and so preserve a particular desirable variety of grape across populations. Given that the evolutionary value of producing seed in the domesticated environment is effectively nil, the seedless grape possesses an evolutionary advantage over seeded varieties. It is more attractive to its prime seed disperser – the human. The perspective of domestication as a mutually beneficial enterprise is also advanced by Michael Pollan’s (2001) lyrical iteration of David Rindos’ (1984) coevolutionary model of domestication¹⁷⁵, and by Aristotelian scholar Robert Wardy (2005). Wardy asks rhetorically, “surely we are *helping* not *making* crops grow?” (p. 77). The grafting and hybridisation techniques of Aristotle’s time were invasive and intensive, but were also seen to collaborate with nature: “if the goal is an abundant yield of *de luxe* fruit, do the agriculturalists’ intentions not dovetail nicely with what the plant strives for naturally?” (p. 79). He compares agricultural techniques with medical interventions, which are artificial but are also designed to help nature reach its

¹⁷⁴ Parthenocarpy – the development of fruit without viable seed – has also been artificially selected for in bananas, figs and other food-bearing plants that have changed to a vegetative mode of reproduction under domestication (Janick 2005).

¹⁷⁵ Presented in Chapter Seven (p. 215).

optimal health. To the extent that grafting, pruning and tending fields assisted nature, they did so in the same way that medicine assists in the achievement of health. Just because the biologically autonomous processes of plants are modified to human advantage does not necessarily mean that these techniques run contrary to nature's own interests.

In the domesticated context, the seedlessness of grapes is an effective, and mutually beneficial, reproduction strategy. When grape plants produce no seed, they are still successfully reproduced by their propagating mammalian companion. Fulfilling the cultural goal for unimpeded consumption of fresh and dried grapes is not at odds with the grape's biological function: "[t]heir most cultural trait – their seedlessness – is also an optimal biological adaptation" (Sperber 2007: 139). Reading the evolution of seedlessness as the maintenance rather than the transgression of the plant's biological autonomy presents the plant as a subjective organism working to fulfil its own ends. The biotic artefact continues to exist *for itself*, if not *by itself*. In recognition of this, Steven Vogel (2003: 16) posits that "an artifact, built by humans as it is, might nonetheless *at the same time* be wild" (original emphasis). Irrespective of its domesticated environment, the food plant remains a Taylorian 'teleological centre of life', and even the seedless grape retains an identity as a 'wild' organism in this sense. Echoing Losonsky's defence of the unsung affective power of the artefact, Sperber (2007: 134) rejects the Aristotelian attribution of artefactual causality as exclusively human, and asserts that in biological-cultural artefacts "both humans and plants have causal powers and these powers interact with comparable weights". It is on similar grounds that Andrew Brennan (1984) suggests that domesticates can only be considered artefacts 'in an attenuated sense'. Vogel (2003: 149) goes even further in recognising the primacy of the artefact's own attributes and argues that "to build *any* artifact is to employ forces that go beyond the builder: in this sense *all artifacts are natural*" (original emphasis):

[t]here is a gap, in the construction of every artifact, between the intention with which the builders act and the consequences of their acts, a gap that is ineliminable and indeed constitutive of what it is to construct something: and we could call this gap "nature" – the nature in every artifact (Vogel 2003: 163).

Traditionally, once a natural thing has been fashioned into an instrument to meet human needs, the gap closes and it loses its previous, natural, identity altogether:

[t]hings that get their functions by virtue of a certain design history will not also get their functions by virtue of [natural] selection history. In transforming a biological object into food or house parts, we normally consider the design function to supplant the natural ones, rather than to coexist with them (Agar 2001: 48)

In emphasising the obdurate materiality and biological processes of the biotic artefact, Sperber attempts to halt this supplantation and rescue the domesticate from becoming a pure artefact. His qualification of the domesticate *qua* artefact suggests that the categories of nature and artefact are not static and mutually exclusive. Rather than a strictly dualistic conceptualisation, there is room for a range, or scale, of artefactuality.

Scales of artefactuality: deep science and the four causes

One reason that artefactual distinctions – Aristotelian or otherwise – seem unable to distinguish between traditional domesticates and genetically engineered plants is that any regime of yes-or-no criteria leaves little room for establishing delineated levels of artefactuality. Environmental philosopher Keekok Lee (1999, 2003a, 2003b)¹⁷⁶ identifies the need for, and offers a more detailed study of, Aristotle’s four causes as a possible route to such a gradation. An acceptance of this gradation hypothesis assumes, at least, that nature and artefact sit at polar ends of a continuum rather than existing in an oppositional dualism where belonging to one category automatically precludes membership to the other. The natural/artefactual split is described by Lee as a dyadic rather than dualistic ontology. Presumably here dyadic is used to refer to a grouping of two that sit in some kind of associative relationship with each other, but not one of mutual exclusivity.

As a starting point, Lee assumes that all cultivars, including the landraces of the domesticatory period of mass selection, are “*ipso facto* biotic artefacts” (2003a: 1). Although domesticates possess an internality that co-contributed to the evolution of their desirable traits, they have an original and ongoing reliance on human intention and activity for their coming into being. They remain “the embodiment of human intentions and ends; and would not have come into existence or continued to exist but for ... human intervention and manipulation” (2003a: 2). In an account of artefacts that allows for gradations of artefactuality, this initial casting of all domesticates as artefacts is less problematic for the task of delineating the difference between biotechnological and other domesticates, than a binary of artefacts and natural entities. Within an ordering of natural / artefactual as a continuum, the domesticate can qualify as an artefact, yet still be regarded as more natural than the genetically engineered food plant.

As previously presented, the difference between an artefact and a natural object is that in a natural object all four of Aristotle’s causes – material, efficient, formal and final – are

¹⁷⁶ The following section discusses material presented in three of Keekok Lee’s publications: *The natural and the artefactual: The implications of deep science and deep technology for environmental philosophy* (1999); *Philosophy and revolutions in genetics* (2003a); “Patenting and transgenic organisms: A philosophical exploration” *Techné* (2003b).

internally generated. A natural object can change, or remain the same, independent of human involvement. For an artefactual object, only the material cause is natural in that it “has not come into existence because of human intention and manipulation” (2003b: 5), while the other three causes have been given to the artefact by their human creator. These may provide the artefact with a source of change, but any change effected through these causes would be *externally* generated, resulting from the design or intentions of the human creator. Only the material cause of an artefact can be a source of internally generated change (or stasis), recalling the previous example of the wooden bed frame and its capacity to decompose due entirely to its material cause (exbiotic timber). Other changes to the bed, such as it collapsing at the joints, are externally caused by either poor design (formal cause), poor construction (efficient cause), or perhaps its overall ill-suitedness for use as a bed (final cause), all of which are given to the bed by its maker. If we accept that these three causes are similarly given to the biotic artefact by its human creator, then its material cause must be comparatively potent. For Bustos (2005), the material cause of biotic candidates for artefactuality is strong enough to give all biotic entities internality and thus a natural status regardless of the level of modification they are subjected to. Not so for Lee, who accepts the existence of the living artefact, but for whom the material cause is important in other respects. As the only common cause of natural objects *and* artefacts, it is within the material cause that Lee locates levels of differentiation along a continuum of artefactuality.

The material cause is key to such differentiation in two distinct ways. In many contemporary cases, the material cause of common artefacts is no longer provided to them by nature. For example, many artefacts are made of synthetic materials. When the material cause is not given to the artefact by nature but is already an artefact itself, a shift from a lower to a higher degree of artefactuality occurs. A rocking horse made from petrochemical plastics has a higher degree of artefacticity¹⁷⁷ than a timber horse of the same dimensions, function and design. Artefacts made from artefacts have all four Aristotelian causes given to them by their human creators. In the case of transgenic organisms, their “efficient, final and formal causes are humanly inspired, imposed and executed, while their material cause is technologically derived from other existing natural kinds” (Lee 1999: 54). It seems at first that this distinction offers only two possible degrees of artefacticity: some artefacts are given their material cause by nature, and others by their human creators. Clearly, though, all material must come from nature in some form, from fossils or molecules, biota or metal ore. And within the range of possible materials from which to construct an artefact, some are

¹⁷⁷ Lee uses the abstract noun ‘arteffecticity’ to denote the state or condition of being an artefact, and this is taken to be synonymous with my previous use of ‘arteffectuality’ to describe this state. It is also possible that Lee intentionally used the term in favour of the more common ‘arteffectuality’ to emphasise its possible meaning (Shorter OED 2002) as a measurable quantity of arteffectuality (as in *humidity* or *porosity*).

more artificial¹⁷⁸ than others, so there must exist some gradation of artificiality. Timber that has been treated with arsenic is more artificial than untreated timber, but plastic made to look like timber is more artificial again. In this rough approximation of degrees of artificiality, it seems that the further away in time and processing cycles the material is from its naturally occurring form, the more artificial it is. The material cause of many domesticated fruit trees, which are deliberately propagated by cloning and grafting and have experienced a small number of sexual reproduction cycles since they were wild, would be less artificial than, say, contemporary wheat plants which, as annuals, are at least 10,000 cycles away from their wild progenitors. If these degrees of artificiality exist in the artefacts' material cause to effect a change in the degree of artefactuality of the plant then the wheat plant would be more of an artefact than an apple tree. Indeed, such a differentiation is indicated in the agronomic and horticultural literature (Janick 1998, 2005). But Lee offers a different interpretation, in which gradations are not drawn along the lines of how much or often the material cause has been humanly modified, but at what level. A material cause may be natural – or, a 'natural kind'; derived from a natural kind; or directly synthesised from the atoms and molecules that comprise the material world. Some artefacts are made from natural substances, others are made from derivations of natural substances, and some are made from completely human-made substances.

This scale of artefacticity is the first way that consideration of Aristotle's material cause allows for differentiation between artefacts. The second, related, way looks to the technological method by which human-made material causes are made. Artificial materials that are produced with craft-based or low technology techniques are less artefactual than those made with what Lee calls 'deep' technologies. The process of domestication is described by Lee as one through which organisms are progressively transformed from being more natural to being more artefactual. This shift is unrelated to the specific qualities that domestication gives an organism – a loss of ecological fitness – but is instead determined by the nature of the technology used in the domesticatory practice. Specifically, the shift from natural entity to artefact is effected by the kind of science that informs the technology that creates the transformation. When viewed by Lee through the lens of scientific development, domestication has three stages: trial- and error- based traditional selection and breeding by farmers (presumably this also includes the original process of domestication); Mendelian genetics and the technique of hybridisation; and molecular genetics and the accompanying technology of genetic engineering. At each stage, the domesticate is produced by progressively 'deeper' techniques made possible by scientific advancement.

¹⁷⁸ The term artificial is used in the sense of synthetic, referring to 'man made' materials, which may, or may

A focus on the depth of technology is a very specific criterion, but is broad enough in its effects to reflect some of the priorities of other approaches to determining artefactuality; for example, the extraction of an organism from embodied history that is central to Preston's (2008) criterion for artefactuality is only made possible by the depth of the knowledge and technology needed to create synthetic organisms from molecular 'bio-bricks'. However, a gradation of artefactuality informed by the type of technology used to implement the human intention is quite different from one that depends on the effect that the technology has on the biological autonomy of the organism. For example, the seedless grape is less able to reproduce itself without human intervention than is RoundUp™ Ready soy, but by the technology criterion the grape would be less artefactual than the soybean. The breeding of the seedless grape was made possible by the specific knowledge of heredity that the rediscovery and refinement of Mendel's laws of heredity afforded. The creation of the genetically engineered herbicide resistant soy bush uses the recombinant DNA techniques of gene splicing and gene insertion that are based on scientific knowledge of molecular biology. The capacity of the r-DNA technique to create organisms with disabled ecological functions, for example, that contain the 'terminator' gene that causes them to set sterile seed, is much greater than conventional post-Mendelian breeding. The seedless grape can be propagated vegetatively while a 'terminated' canola plant has no mechanism for reproduction unless it spontaneously evolves a similar capacity. But the ability to hinder biological function is not the defining feature of Lee's assessment of gene technology, with respect to it yielding more artefactual creatures. The difference between the two technological stages is that the scientific knowledge underpinning the more recent technology is 'deeper' than the preceding knowledge.

The concept of depth in scientific knowledge is relational, whereby a less deep theory can be explained in terms of a deeper theory. The Mendelian genetics that informs the creation of the seedless grape can be explained in terms of the molecular genetics that informed the herbicide resistant genetically engineered plant. The deeper of two or more theories is "more comprehensive in scope, explaining a wider range of data, accounting for more variables in their causal contribution to a particular phenomenon" (Lee 1999: 70). Depth also refers to the level of matter and materiality that the science can observe and describe, where a deeper theory is concerned with explaining phenomena at the more micro level. Newton's macro level physics is less deep than the micro theory of quantum physics; and Mendel's description of dominant and recessive *faktors*¹⁷⁹ is less deep than the complex mechanisms

not, meet conditions of artefactuality.

¹⁷⁹ See Chapter Two (p. 71 [fn 80]) on the evolution of the idea of the gene.

of heredity accounted for by molecular genetics. Because depth refers to the more fundamental levels of material reality, deeper technologies built upon deeper sciences give their human creators a greater level of control over the material results of their activities. The Mendelian phase of plant breeding technology gave humans a relatively weak form of control over their biotic artefacts, where molecular genetics gives them a strong form of control. Thus the Flavr Savr™ and the Mikado tomatoes are both artefacts, but the biotechnologically produced plant is *more* artefactual than the experimentally hybridised one: “the deeper the science and its accompanying technology, the greater the degree of artefacticity in the artefacts produced” (1999: 85).

Domination and artefactuality

When the level of human control over the form and function of biotic artefacts is lower because the technology that is used to effect that change is shallower, the organism’s own biological and species-specific purpose – or *tele* – is still able to be expressed. The less precise the human control, the more that the organism’s own *tele* prevails. Lee’s formulation of the relative artefacticity of domesticates tells against Bustos’ assertion that a plant’s possession of internality necessarily excludes it from being an artefact. Indeed, the internality of genetically engineered organisms in particular is immaterial in light of the successful redirection of these internal propensities to human-determined ends: “[t]hat they are alive, that is, breathe, ingest nutrients, reproduce, is, from this perspective, totally irrelevant, as these capabilities of theirs have been captured by humans so that as ‘designer organisms’ they no longer live out their own *tele*” (1999: 53). The level of modification undergone by genetically engineered plants means that the ends for which they strive through their biological workings are no longer their own: deep biotechnologies create more artefactual artefacts because the modification and recombination of genetic material diminishes the biotic entities’ own intrinsic *tele*.

Mendelian hybridisation techniques, although also practiced within the theoretical framework of hereditary genetics, still allowed for the preservation of *tele* as an elemental ‘wildness’, and these domesticates “retain something of what their forebears had before humans intervened” (1999: 54). In this regard the difference between pre-Mendelian and post-Mendelian breeding is relatively small. The *tele* of the organism can coexist, albeit in a diminished state, with the externally imposed function given to the organism by its human ‘creators’. On the other hand, the techniques of biotechnology replace coexistence with domination – “a relationship between two parties where one party (the dominator) totally and successfully imposes its will on the second party (the dominated)” (1999: 118) – and

which leaves no room for the perseverance of characteristics that belong solely to the plant's own inclinations.

Domination as a necessary condition of an entity's artefactuality is taken up in Stephens' (2000) conceptualisation of artefactuality and artificiality. The significance of the relationship of domination to the loss of naturalness in humanly created objects echoes Schummer's (2001) perspectivism, in which artefactuality is in the eye of the beholder, and Katz's criterion that artefacts are necessarily put to anthropocentric instrumental use, such that "[t]he creation of artefacts is ... central to the human project of the domination and subjugation of the natural world" (Katz 1993: 230). Stephens (2000: 279) distinguishes objects of human making by the level of instrumental rationality that is employed in their making:

[a]rtefacts are necessarily manifestations of human intent, certainly, but the extent to which they may be seen as wholly separate from or opposed to nature is dependent on the rationale, knowledge, social and productive conditions and cognitive orientation of the producer.

What is important to Stephens, who describes these products of domination as 'artificial' rather than merely 'artefactual', is the mode of orientation. While artefacts can include benign eco-friendly technologies, books and architecture, "the artificial is defined not merely by the fact that it subjugates nature's dynamics to human instrumentality, for all artefacts do this, but that it explicitly normatively intends to oppose and supplant them" (p. 287). By this criterion, "agribusiness areas of total non-indigenous monoculturing [and] genetic manipulation technologies" (p. 287) are considered to be products of this orientation, though conventional domestication and smaller scale agricultural production are not.

The significance of human-nature domination to the designation of artefacts goes beyond the relational dimension of the co-creation of biotic entities (examined in detail in Chapter Seven). It is also a key problem for the axiological implications of the natural/artefact ontology. In the natural/artefactual pairing, nature is the ontological category of all that has come into being in the material universe *by itself*, independent from human intentional goal-directed activity. The biotic results of early domestication, pre-Mendelian selection and post-Mendelian breeding, are artefacts that have retained a degree of naturalness through the obdurate nature of their own biology and goals. They have not been entirely transformed from natural to artefactual objects through these techniques, but exist as both natural and artefactual kinds. Genetic engineering, on the other hand, represents the completion of this transformative process, so that nature – as 'foil to the artefactual' – no longer exists in food plants that are biotechnologically produced.

When Bill McKibben (1990) lamented the ‘end of nature’, the subject of his focus was ‘pristine’ natural areas. When no place on Earth remained free of the traces and impacts of human activity, nature – as the foil to the artificial – disappeared. However, nature as that which exists *by itself* did not. Lee describes the end of McKibben’s pristine nature as the first death of nature. The second death is the end of nature as an independent entity with non-anthropogenic origins through its replacement by artefactual kinds. However, this replacement is particular to those entities that participate in the domesticatory relationship (and those that are subsumed in other bioengineering industries, such as tree farming). Wilderness areas, even those that have been restored, remain immune. These are areas, though, that an environmental ethic would leave alone as much as practicable. Lee argues that the ontological elimination of nature by the domesticatory relationship between people and plants leaves only humans and their artefacts. With genetically engineered food plants, humans no longer have a domesticatory relationship with nature but are instead engaged in the creation of ‘narcissistic objects’. The ‘unnaturalness’ of these plants is that they are paradigmatic artefacts that differ significantly from the partial or lower level artefacts created by shallower technologies. What appears as a small step in the adoption of more effective technologies in fact represents the elimination of nature as an ontological category from the domesticatory story.

So, whither the value of the biotic artefact in this ontological shift? Lee’s ethic is for the protection of nature *sans* artefact. It does not recognise the ethical considerability of artefactual nature in itself¹⁸⁰ (Castree 2003a). As discussed in Chapters Three and Four, there is a moral dualism built into the nature/artefact split; a ‘dangerous dualism’ (Stephens 2000) that poses problems for the moral acceptability of the distinction (Lo 1999). Even if artefacts are products of human domination, they still retain some autonomy and retained wild qualities in their Aristotelian material cause, and their obdurate biological natures. In a comprehensive critique of Katz’s formulation of artefacts, Lo (1999) argues that the autonomy and subjectivity of nature that grants it value in its own right should still be respected even in cases where it is restricted by contingent factors. To illustrate, she employs the analogy of slavery to show that an entity can possess autonomy without exercising it: “[t]rue respect for a person’s autonomy persists even when the person’s autonomy is suppressed under domination. Similarly, if one truly respects the autonomy of nonhuman nature, one will respect that autonomy even when it is confined by external factors, such as human disturbance” (p. 265). The biotic artefact ought to qualify for moral considerability “[o]therwise, subjects struggling and suffering under domination, having

¹⁸⁰ See also Vogel’s (2003) argument for the inclusion of artefactual nature within environmental ethics.

their autonomy unjustly suppressed, would be taken as morally less valuable, and their already existing domination could be easily used to justify further domination” (p. 264). It is this logic that underlies the implicit and explicit endorsement of genetic engineering in agriculture; simply iterated: “[m]ost genetic engineering is done to already domesticated species, the ones the green movement isn’t interested in” (Noske 2004: 8).

Conclusion

An artefact is a human creation, but it is not just any human creation – pollution, children, footprints and friendships are created by humans but do not qualify as artefacts. Artefacts are objects that are deliberately designed and created by humans with their intended function well and truly in mind. In Eric Katz’s formulation, an artefact is also an object whose creation was designed to satisfy exclusively human needs. However, with strong evidence that humans have consideration of nonhuman others in the creation of artefacts, like concern for pets and wildlife in the creation of kennels and fences, an anthropocentric focus is probably typical, but not essential, to the categorisation of humanly created objects as artefacts.

As a patentable object, the genetically engineered plant is unquestionably a product of deliberate human intention and, thus, an artefact. It is also an invention in that it could never have evolved naturally. The biotechnological entity is not typically set apart from other domesticated food plants by virtue of its artefactual status. Domesticates are commonly considered to be artefacts as well, on the basis that their domesticated qualities of larger, sweeter palatable parts, and a relative inability to survive outside the agricultural field, are the direct result of the human activity of securing and selecting their food source. Human intervention, intention and, eventually, deliberate design have been instrumental in effecting these genetic and phenotypic changes in the domesticated plant. The extent of the human element in the creation of domesticates is less uncertain than for products of genetic engineering. Ecological, biological and climatic factors beyond either the control or consideration of human actors factored significantly in the emergence of domesticated plants. In particular, the biological responsiveness of the kinds of wild plants that were able to be domesticated was central to the development of field agriculture, and this responsiveness remains paramount in the creation of the most domesticated of cultivars. Domestication is a fusion between human intention and the biological functioning of the plant in response to its environment.

But if the slightest dependence upon human intention for its creation is all that is required for an entity to be an artefact, then domesticated plants are definitely no longer natural

objects, and the qualitative difference between the incidental domestication of Neolithic times and the calculated engineering of organismic traits into plants in the biotechnology laboratory is inconsequential to the classification of both genetically engineered and traditionally domesticated plants as artefacts. Given that the biological retains so much primacy throughout domestication, then the role of intention is attributed too generously. If an increase in the capacity to make manifest that intention through more precise technological intervention has no bearing on whether the entity is more of a humanly designed object than its ancestors then the designation of artefact is also being applied too broadly. The particular case of the biotic artefact with its capacity to grow, develop and reproduce calls for an ontology that allows for a gradation of artefactuality.

It is tempting to respond to this quandary by taking the position that the living entity's level of biological autonomy – its Aristotelian internality – precludes it from ever being considered an artefact. However, the fact of genetically engineered organisms' patentability, and the essential role that deep science and technology has played in its becoming, does not allow the biotic artefact to be dispensed with so easily. Establishing certainty that the domesticate is an artefact has been tricky even without the difficulty of accurately ascribing human intention retro-historically, and it is even argued that Aristotle's philosophy could not have adequately accounted for the status of the domesticates of his time. Indeed, interpretation of the Aristotelian definition of artefacts can be used to support the exclusion of all living things as artefacts and the classification of biotic entities as artefacts according to the perspective of the artisan. With the twists, turns and dead ends of trying to determine the ontological status of domesticates and genetically engineered organisms, and the new imperative to identify their respective degrees of artefactuality, it seems reasonable to ask, first whether Aristotelian distinctions actually offer any way forward or if it is asking too much that they remain relevant after thousands of years of unforeseeable agricultural and technological development and, second, whether the axiological implications of according artefactuality to biotic entities are defensible.

The tenacity of the criticism that the autonomy of nature ought to be respected even when it is suppressed depends on how this autonomy is conceptualised in the domesticated context. In the previous chapter, it was recognised in terms of the retained wildness of domesticated nature. In this chapter, it has featured as the obdurate biological nature *qua* Aristotelian internality of domesticates, and the primacy of evolutionary adaptiveness to the production of domesticated forms. Both of these elements are represented in Lee's use of the Aristotelian material cause of biotic artefacts, and both have presented as key obstacles to the definitive categorisation of domesticated plants as artefacts proper. There are two conclusions to be drawn from this discussion. First, the nature/artefact distinction, even

where it is conceptualised as a continuum rather than a straightforward dichotomy, is too severe to account for the different levels of human intentionality manifested by domesticates and biotechnologically produced plants, or their different levels of natural value. The axiological implications of the dualism are such that there is no way to include domesticates *qua* artefacts in an environmental ethic. Secondly, the conceptualisation of both domestication and the production of artefacts as a process of domination neglects the role that the somewhat recalcitrant wildness of domesticates has played in resisting the categorisation of domesticated nature as a pure artefact. Rather, the production of domesticates relies on a decidedly ekphrastic relationship between nature and humans. The qualities of this relationship are borne out in discussions in forthcoming chapters.

Chapter Six

Wildness: reconciling the wild/domesticated split

Introduction

This chapter is chiefly concerned with the resolution of the strong ethical discontinuity between wild and domesticated nature that is characteristic of the field of environmental ethics and that has posed consistent problems for the coherence of academic and popular debates about the import of biotechnology for nature. The traditional emphasis in environmental ethics on wild nature has been shown to represent a loss for the development of comparable theories of value for domesticated nature. This need not be the case. Contributions to biotechnology debates that have upheld popular concerns about the philosophical implications of genetic engineering have tended to defend domesticated nature against biotechnological modification with respect to its previously unrecognised wild qualities. In this regard, and somewhat paradoxically, the field provides numerous resources for the task of identifying and appreciating wildness. This chapter draws on these to elucidate the particular character of wildness that can be retained under domestication and to challenge the apparent mutual exclusivity of the wild/domesticated dualism. By tracing the conceptual and material imbrication of these two categories, it offers a series of interpretations of the concept of wildness that affirm the place of domesticated nature *qua* nature within the field of environmental ethics and that can be used as a basis for a sound environmental ethics critique of the adoption of genetic engineering technology in agriculture.

The recognition of wildness in domesticated nature entails the extraction of wildness from its traditional home in wilderness landscapes. The conceptual separation of wildness from wilderness has been undertaken elsewhere in environmental ethics, chiefly in service to critical assessments of the extent of wildness in modern wilderness. The quality 'wildness' has also been differentiated from the place 'wilderness', and identified as existing in locations outside designated wilderness areas. Human, urban and restored nature have all been cited as places where the quality of wildness – taken as roughly synonymous with the qualities of independence, autonomy and freedom – persists. Similarly, domesticated plants have been recognised as retaining characteristics of wildness beyond the simple fact of being biological entities by Rolston (2002) and Verhoog (1992), albeit in a rudimentary

manner, in their respective critiques of genetic engineering presented in Chapter Four. In Chapter Five, the arguments advanced by Sperber (2007) and Lee (1999) against the framing of domesticated organisms as pure artefacts also highlighted the independent and autonomous characteristics of these plants. Further, each of these authors contend that these characteristics ought to be recognised and valued on the same basis that the wildness of wild nature is recognised and valued. To this end, the project of identifying elements of wildness in domesticated nature follows on from the problem of definitively describing domesticated plants as artefacts, and advances three key ways that wildness persists in domesticated plants in an ethically significant way.

The coexistence of domestication and wildness becomes visible when the scale of apprehension shifts from that of the landscape to that of the organism (notwithstanding recognition of the ecological embeddedness of the agricultural system in its surrounding environment). An investigation of the domestication syndrome that characterises domesticated organisms and provides the working definition for the wild/domesticated distinction, progresses the first definition of wildness as diversity. This type of wildness is observable in domesticates and is conserved by systems of agricultural production that value and encourage inter- and intra- specific diversity in the field. As a technology that consolidates the monocultural production model, biotechnology is antithetical to wildness *qua* domesticated diversity. Wildness is also able to be articulated in terms that have implications for biotechnology with respect to the previously identified tendency to narrate genetic engineering as merely another benign step in evolution under domestication. The quality of wildness is seen in the evolutionary qualities of mindlessness and indeterminacy, which are ethically significant features of both natural and artificial evolution and are considerably endangered by the over-determinism of genetic engineering. The third understanding of wildness advanced in this chapter is done so through the concept of otherness. This understanding of wildness maintains, rather than contradicts, the traditional mutual exclusivity of wild/domesticated in which wildness *qua* otherness is that which lies outside the reach of domesticatory practices and asserts itself through the independent processes of biological growth and form. By extending domestication to the level of the gene, biotechnology conceptually represents the removal of the remaining wildness of domesticates. The concept of wildness as otherness is particularly useful for the case of domesticates in that 'otherness' contains an intrinsic reference to relationship, and domestication is, above all, a relational phenomenon.

The recognition of wildness within domesticates is approached with the goal of bringing domesticated nature firmly into environmental ethics. The expansion of environmental ethics to include consideration of domesticated as well as wild nature is supported by calls

from within the field to provide a more positive account of humans in nature (Light 2001; Hettinger 2002; King 2003; Hettinger 2005) and to move beyond entrenched dualistic thinking (Plumwood 1998b, 2001, 2002). The wild/domesticated split translates practically into a respect/use dualism, in which the myriad possible forms of human relationships with nature are reduced to a false choice between either ensuring our absence from nature or endorsing its limitless and destructive instrumental use. The sharp contrast between our respect for wild nature and the pure instrumentality with which resourced nature is used “does not support a culture of respect for ordinary land or for nature in context of everyday life” (Plumwood 1998b: 667-668). The goal is to find meaningful ways to appreciate domesticated nature as nature that allow for differentiation between types of domesticatory interventions on environmental ethics grounds. The possible forms that this might take are developed in the seventh and final chapter.

The traditional wilderness concept

The task of finding wildness in domesticates is preceded by the separation of the quality of wildness from its traditional location in geographical wilderness. Recent developments in the concept of wilderness have revised the traditional definition of wildness as wilderness areas comprising large tracts of uninhabited land that contains a multitude of species and natural ecosystems untouched by humans¹⁸¹. This definition has previously been taken as the dominant form of wildness in environmental ethics literature, and a corresponding popular association between wildness and wilderness has meant that these two terms were often used interchangeably to denote the wilderness landscape. The synonymous treatment of the terms is prominently illustrated in the persistent misquoting of Thoreau’s proclamation on the value of wildness, “in wildness is the preservation of the world”, as “in *wilderness* is the preservation of the world”¹⁸². Although wilderness may most visibly, aesthetically and influentially represent the quality of wildness, wildness is the broader category (Chapman 2006). Along with qualities of naturalness, stability and integrity, *inter alia*, wildness is an otherness that represents a counterpoint to the strictly human realm, which is what is valuable about wilderness (Hettinger & Throop 1999). The conceptual separation of wildness from wilderness is strongly linked to understandings of wilderness as both a besieged landscape and a contested concept.

¹⁸¹ This is wilderness as defined in *The US Wilderness Act 1964* section 2c as “an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain”.

¹⁸² See Jack Turner’s *In wildness is the preservation of the world* (1995).

Much attention has already been given to the task of disentangling wildness from wilderness. Chiefly, this has been undertaken in service to assessments of the wildness of contemporary wilderness areas that are, by spatial and social necessity, bounded in designated parks and reserves. Here, the quality of wildness features alongside the quality of naturalness as the primary, often competing, conservation priorities in the management of wilderness areas¹⁸³. While ‘naturalness’ relates to the indigeneity of the plant and animal life and the lack of buildings and other cultural artefacts, ‘wildness’ describes the autonomous, independent qualities of the landscape and its inhabitants and the lack of human influence or interference in their processes. However, human intervention is often required to maintain the naturalness of wilderness areas, such as through the culling of overpopulating animals or the clearing of underbrush to mitigate against devastating bushfires. Managing wilderness for naturalness ironically entails a diminution of wildness. Turner (1995) argues that the wildness of wilderness areas is diminished by the limited size of artificially-bounded parks and reserves, the lack of large predator species, and the proliferation of information signs and constructed tracks. These factors are, in part, attributable to the creation and presentation of wilderness almost exclusively *via* the language and priorities of ecological science and biodiversity, which precludes official recognition of the actual quality of wildness as a key valuable element of wilderness areas (Ridder 2007; Light nd).

The overriding conclusion of these critiques is that contemporary wilderness can be somewhat wanting for wildness (Turner 1995; Cronon 1996; Aplet *et al.* 2000; Landres *et al.* 2000; Ridder 2007). The kinds of measures of wildness that tend to be cited for this conclusion – for example, that wilderness must offer an opportunity for solitary contemplation and that one ought not encounter any kind of machinery while in wilderness (Aplet *et al.* 2000) – are still embedded in a landscape, whether ideal or existent. Although Turner (1995) is directly concerned with distinguishing the geographical place of wilderness from the self-willed quality of wildness, the distinction is made to evince that the place is too small or is otherwise tainted by human contrivance to contain the quality, not that the quality is necessarily available elsewhere.

A distinction between wildness and wilderness that allows for the recognition of wildness in other landscapes was made by William Cronon (1996) in his influential critique of the wilderness concept¹⁸⁴. Cronon, too, challenged the previous conceptualisation of wilderness

¹⁸³ There has been an ongoing debate about the relative weighting that ought to be given to naturalness and wildness in conservation biology and wilderness management (Ridder 2007; Landres *et al.* 2000).

¹⁸⁴ The publication of Cronon’s deconstruction of wilderness in a special issue of *Environmental History* (1996, Vol 1 Issue 1) was accompanied by a series of responses to his thesis that offered a vehement defence of wilderness and the centrality of the wilderness concept, and Cronon’s article is the original text for the critique of wilderness.

as unproblematically wild in the sense of being devoid of human activity or influence. Wilderness areas are shaped and sustained by human intervention. Many such areas were previously inhabited and changed by indigenous people, such that past designations of a wilderness area not only represented the political erasure of indigenous people¹⁸⁵ (Langton 1995; O'Neill 2002) but also rested on an inaccurate account of how the ecologies of these areas evolved. In Australia, the results of indigenous fire-stick farming in effecting a change from dense rainforests to open woodlands is a case in point (Langton 1995). When wilderness was proclaimed in these situations it was a case of 'deceptive naturalness' (Plumwood 2001:19), where "[c]ounting something as 'nature' in the sense of 'pure nature' when in fact it has a human contribution (not merely a human influence) hides or denies the human social relations that have gone into that construction". Although wilderness has been conceptualised quite differently for different purposes and in different historical periods (notably, the barren and desolate wasteland of the Bible, and the otherwise valueless raw material of land awaiting transformation into wealth and resources of the frontier [Oelschlaeger 1991; Cronon 1996]), the wilderness landscape has remained one that is dichotomously contrasted with both the built landscape and the human world of civility. The positive contemporary vision of wilderness draws its value from this contrast (Salleh 1997: 43), where "wilderness is sacred precisely because it tells [our] absence". The 'trouble with wilderness' lies in the effect of this dichotomy. It is not so much that wilderness is mistakenly taken to be truly wild but that the privileging of wilderness, *sans* all human presence, over other forms of wildness in nature maintains an unbridgeable human/nature separation. Our insistence that wilderness is the sole source of wildness precludes us from forming meaningful material relationships with nature (interventions in service to maintaining the naturalness of wilderness areas notwithstanding).

Wilderness may well entail a sense of 'going home' (Muir 1901: 1) to the ancient human origins in the wild environment (Shepard 1973, 1998) but, in the contemporary setting, the wilderness *domus* is spiritual rather than practical¹⁸⁶. In the shadow of the wilderness landscape, the agricultural landscapes that do provide us with food are regarded as "second-best landscapes that have some environmental value to the extent to which they approximate to the 'real thing'" (O'Neill 2002: 36), while the wilderness landscape continues to be judged positively as the 'pre-agricultural original'¹⁸⁷. Accordingly, "wilderness leaves

¹⁸⁵ See Langton (1995) on the role that wilderness plays in perpetuating the framework of colonisation by ignoring the effects of pre- and post- colonial human activity on the landscape.

¹⁸⁶ This is, of course, restricted to the contemporary context – only counting the agricultural *domus* as home excludes 90 percent of humans that have ever lived (Cassidy 2007).

¹⁸⁷ See Chapter Three (pp. 98-99) on the cosmological account of agriculture as a 'fall from grace'.

precisely nowhere for human beings actually to make their living from the land” (Cronon 1996: 80). The nature that we ‘get back to’ in the wilderness experience is one that reinforces the firm boundaries between humans and nature, and between wild and domesticated nature (see also Whatmore & Thorne 1998). Thus, the wilderness experience of vast and awe-inspiring scenes in which we are unambiguously confronted with the extent and beauty of nature’s otherness, which is frequently held up as providing inspiration for ecological action (for example, Havlick 2006), may not be the best and only way to meet this imperative. For Cronon, the experience of wildness and the motivation to act with regard for it can be cultivated in “wild places much closer to home” (p. 86). An appreciation of local nature as a more effective way to cultivate environmental care is taken up elsewhere by Light (nd) in his argument for the value of restored ecosystems as a positive, participatory, environmental relationship. To the particular issue of wildness, Cronon (1996: 88) argues: “wilderness gets us into trouble only if we imagine that this experience of wonder and otherness is limited to the remote corners of the planet, or that it somehow depends on pristine landscapes that we ourselves do not inhabit. Nothing could be more misleading”. Wildness can be found elsewhere.

Even from within the environmental ethics framework that values the wilderness landscape as the “ideal of nature independent of human intervention that forms the standard from which others are judged” (O’Neill 2002: 36), intermediate degrees of wildness are found in “extensively humanised places like backyards, gardens, or New York’s Central Park [that] carry important wildness value in the right context and when contrasted with more humanised places” (Hettinger & Throop 1999). For these authors, the drive to find wildness in other places is, in no small measure, made necessary by the loss of wildness from the wilderness landscape. What was in abundance at the end of the eighteenth century was in short supply as we entered the twentieth century as a result of massive population growth, and the attendant practice of land clearing for agriculture, industry and housing (Oelschlaeger 1991). The changes undergone by wilderness have been qualitative as well as quantitative. Humans have so influenced the content and processes of wilderness that there is now no significant part of the planet that does not bear evidence of human activity; it is in recognition of this that Bill McKibben pronounced the ‘end of nature’ in 1990. Rolston (1999b: 156), while maintaining that nature that has been only slightly or partially disturbed still makes up the majority of the earth’s terrestrial surface, accepts that wilderness *qua* ‘pristine’¹⁸⁸ nature is now very hard to find and that humanly ‘created’ nature is taking centre stage. He states, somewhat drastically: “the epoch of evolutionary nature, and even

¹⁸⁸ Following Cole (1996), ‘pristine’ is taken to denote “what would have existed in the absence of post-aboriginal humans” (in Aplet *et al.* 2000: 89).

ecological nature is over". Notwithstanding the criticism that a reconfiguration of wildness ultimately lends support to the ongoing destruction of wild nature (Cafaro 2001a; Crist 2004), or the contrasting claim that wild nature has never been as wild as we would imagine it to be¹⁸⁹, the increasing shortage of wilderness landscapes does provide an obvious impetus for finding and protecting wildness elsewhere.

It is not only the scarcity of wildness in wilderness that invites its recognition within domesticated nature. The wholly wild status of wild nature has comprehensively been brought into question in the literature; much more is yet to be done on the equivalent task of challenging the wholly domesticated status of domesticated nature. Ethnobotanical studies have documented indigenous people's flexible definitions for wild and domesticated plants (Cassidy 2007), and anthropological studies have similarly evinced culturally variable distinctions between wild and domesticated animals (Haber 2002; Massetti 2006). The uncertain place of the wild and the cultural within domesticated nature has been given critical attention in archaeobotanical, archaeozoological, geographical, cultural and animal studies scholarship, but these revisions are yet to permeate the field of environmental ethics. Thus far, Rolston's (2002) and Verhoog's (1992) suggestion that domesticated nature could have retained a level of wildness and that this wildness could provide an in-principle basis for objections to biotechnology that further diminish this wildness stand as the only overt claims for the meaningful wildness of domesticates within an environmental ethics framework. With consideration of Cronon's appeal that we begin to recognise and honour the wild as we encounter it in less-than-wild places, and of Steven Vogel's (2003: 162) forecast that "[o]nce we abandon the fetish that only a landscape that humans have never touched could possibly be natural or wild, we might begin to see that even ongoing human action within the landscape could be consistent with its ongoing wildness, and could indeed maintain it", the remainder of this chapter is concerned with the explication of three possible forms of retained wildness in domesticated nature.

Wild/domesticated

The practical distinction between wild and domesticated plants is made on the basis that domesticates have a common set of morphological and ecological traits that make them more useful for human purposes, and less able to survive without human assistance or

¹⁸⁹ From the decidedly anti-dualistic perspective of science and technology studies, wild nature is presented as more domesticated than previously suspected, even before its subsumption into the diminutive framework of national parks. In their comparative study of wild animals as they appear in Roman gladiatorial performances and in the scientific documentation of reserve habitats, Whatmore and Thorne (1998) argue that the social and the wild have long been strongly imbricated.

outside the confines of the agricultural field. Insofar as the terms ‘wild’ and ‘domesticated’ are straightforwardly applied to organisms that either do or do not possess these traits, they pertain to real, measurable qualities. This categorisation becomes problematic, however, when ‘wild’ and ‘domesticated’ are conflated with ‘nature’ and ‘culture’ and adopted as strict ontological categories. In the contemporary Western world at least, the wild/domesticated dichotomy maps readily onto the problematic nature/culture dualism, in which the nonhuman is conceptualised and defined by contrasting reference to the human, and the wild in contrasting reference to the domestic (O’Rourke 2000). When the wild/domesticated pairing is taken as an oppositional ontology in which each must maintain an absence of the other’s qualities in order to remain ontologically meaningful¹⁹⁰, there remains little room for exploration of their imbricated histories and potentialities: to describe an organism as wild precludes its possible domestic qualities, and to speak of an organism as domesticated disqualifies its claim to wildness. This is a classic problem of dualistic thinking and its effects have been much noted elsewhere¹⁹¹. In practice, it is nearly as difficult to trace the dividing line between wild and domesticated as it is to identify a clear and consistent boundary between nature and culture, or natural object and artifice.

Environmental ethics has traditionally maintained the mutual exclusivity of wild and domesticated nature and its respective independent/dependent relationship to humans, particularly as the artefact/natural object distinction. This underlies the division of the natural world into two moral domains – the domesticated nature that we use, and the wild nature that we (ought to) revere – which has significantly limited the instructiveness of the field’s critical appraisals of agricultural genetic engineering (see Chapter Four). Plumwood (2001: 12) describes these two domains as ‘hyper-separated’, ethically polarised in “an emphatic form of separation that involves much more than just recognising difference”. The dichotomous distribution of value of this use/respect dualism, first, entails a necessary denigration of domesticated nature and, second, significantly restricts the range of possibilities for the development of a constructive ethic for human relationships with other organisms. A working conception of wild and domesticated nature as hyper-separated,

¹⁹⁰ For example: “I would suggest that we start from the meaning of the opposite of what we are seeking to interpret. That is, I would start from the question of what a domestic species is not. The obvious answer is that a domestic species is not a wild species; a wild taxon is, by definition, a biological organism capable of living in the natural state in which it is born, irrespective of any human intervention. Therefore, every domestic biological element must, in the first place, not be wild” (Masseti 2006: 89).

¹⁹¹ Specifically in environmental ethics scholarship see Plumwood (2002); Haila (2000); Stephens (2000); Soper (1999). For the possible synthesis between environmental ethics and social studies in recognition of the uncertainty of the nature/culture distinction, see Goldman & Schurman (2000); Smith (2001). For the study of the construction of concepts about nature and the incorporation of nature into social theory, see Gerber (1997); Castree (2001); Demerit (2002); Lease (1995); Jones (2002), and into agricultural studies, see Goodman (1999, 2000); Fitzsimmons & Goodman (1998).

mutually exclusive categories limits the choice to adopting “either quietistic or imperious stances toward nonhuman life forms” (Acampora 2004: 221).

Yet there is much that lies between “the poles of pristine wilderness eternally untouched by artifice and a world completely created by design of external agency” (Acampora 2004: 221). Unpacking the wild/domesticated division of the natural world reveals a range of human relationships with other species that cannot be neatly categorised as either strictly domestication or definitively independent. Domestication is not a simple descriptor but a ‘problematic and elusive concept’ (O’Connor 1997: 151) that often stands in for, but does not cover, all the different and diachronic relations between humans and other species. O’Connor (1997: 151) offers animal kingdom examples of the “domestic fowl *Gallus gallus* (domestic), house sparrow *Passer domesticus* (not domesticated therefore wild, but closely associated with humans), feral pigeon *Columbia livia* (formerly domesticated but ‘gone wild’ and conspecific with ‘wild’ rock dove) and puffin *Fratercula arctica* (wild)”. Neither does plant life fit only within one of the dualistic categories. Some domesticated plants have retained their wild characteristics in the field, and some plants that were once domesticated and strongly integrated in human society are now wild again (Weiss *et al.* 2006). Some undergo a similar transformation in our imaginations: the ‘wild’ hedgerows of England that contemporary environmentalists fight to preserve were once “the hated emblems of enclosure” (Rogers 2000: 319).

If the material differences between wild and domesticated plants are not rigid, static or comprehensive, neither do wild and domesticated forms occupy entirely independent environments. As closely as contemporary agriculture resembles factory production, it is still dependent on decidedly undomesticated natural elements. The biological, geological, climatic, meteorological and ecological forces that influenced evolutionary history – and even determined the original availability of edible plants – are still in play. The agricultural field is a humanly-created environment that “remains inescapably dependent on the natural world – on photosynthesis, biochemical cycles, the stability of the atmosphere, and the services of non-human organisms” (Worster 1990: 1094). Agricultural activities can exercise a degree of control over the direct environment of the food plant by establishing its relative separation from the ecological impacts of its surrounding environment. The agricultural field is irrigated, aerated, fertilised, and any competition for this newly created environment is literally weeded out. Where wild food plants were ecologically integrated with their surrounding biota and local hydrological cycles, farmed crops relied on a comparatively isolated environment that had been significantly altered according to the needs and capabilities of the human community. Harvest times, irrigation needs, weeding requirements and soil preparation periods of agricultural activity are still reliant on plant

growth rates, the frequency of regional precipitation, the health of the adjacent ecology, and the local weather patterns. The corresponding effect of the domesticated landscape on the wild, in the form of horticultural and agrochemical pollution, as well as through land clearing for cultivation, has been well documented as the environmental impact of industrial agriculture.

Significantly, there is a strong relationship of dependence between domesticated plants and their wild relatives. Although domesticated plants now occupy a significant area of the planet's landscape¹⁹², the domesticated realm is very small in terms of the number and variety of plants that comprise it¹⁹³. Its narrow genetic base makes it vulnerable to pests and diseases, and dependent upon the influx of genetic diversity from its wild and less domesticated relatives to remain resistant. This dependence is traced in the following section to show two things: one, that the nature of the dependence of domesticated plants on wild resources challenges the conceptual separation of the two 'realms' and, two, that genetic and phenotypic diversity is a quality that can be positively associated with wildness, even in the attenuated form it exists in under domestication. Such diversity is the first of a series of characteristics that are considered representative of wildness and that can persist within the domesticated form.

Diversity, dependence, and the *domestikationssyndrom*

The aggregate of physical traits that are observable across a range of domesticated species, the 'domestication syndrome' – coined originally in German as the *domestikationssyndrom* (Hammer 1984) – has three main features: a loss of ecological autonomy, a loss of genetic diversity accompanied by an increase in phenotypic diversity, and an increase in the size and improvement in the flavour of edible plant parts. Domesticated plants rely on humans to disperse their seeds, to provide nutrients and water, and to protect them from various forms of predation. Wild plants perform these functions for themselves, or in conjunction with other wild organisms. They rely on their own chemical or physical barriers to predation, and mechanical or symbiotic methods of reproduction. Wild nature is able to live, thrive and reproduce independent of human involvement¹⁹⁴. Fully domesticated plants lack ecological autonomy and are dependent on human activity for their very survival. They have lost their

¹⁹² Cultivated land that is used to grow all annual and perennial crops covers 18 percent of the earth's terrestrial surface (CIA 2005).

¹⁹³ Of the 200,000-250,000 flowering plant species, nearly 5000 have been cultivated as some time, but only around 250 species (or 0.1%) have been fully domesticated and routinely traded (Heywood 1999; Fowler & Mooney 1990).

¹⁹⁴ That wild plants can and do exist without the need for human intervention is behind the classification of wild food plants as "intrinsically wild" (Evans 1996).

physical and chemical defences against herbivory, their seed dormancy, and their seed dispersal mechanisms – the “major diagnostic characteristic” (Blumler and Byrne 1991: 24) of the domesticated plant in the archaeological record. Seeds are dispersed by wild extant and wild progenitors of cereal crops when their seed heads disarticulate, or ‘shatter’, discharging seeds onto the ground or into the wind. Similarly, wild legumes have dehiscent seed vessels that ‘pop’ when ripe. Domesticated legume pods are indehiscent; they do not burst when mature but remain coupled to the plant, where they are harvested. This non-shattering characteristic was unconsciously selected for by human harvesting practices¹⁹⁵ – seeds that were retained on the plant were those harvested and resown. The domestication of root crops and leafy vegetables exerted no selection pressure on seed retention, so these plants retained their seed dispersal mechanisms (Evans 1993). The seeds of wild plant populations also exhibit a high rate of dormancy, spreading the risk of drought, predation or other threats to survival. Dormancy is produced when seed casings are of varying density, or the plant produces other ways to inhibit germination, and is an important evolutionary adaptation to environmental and other fluctuations in the wild. Seed dormancy affects the survival of domesticated plants in the agricultural field and has been selected against by year-by-year harvest and resowing practices.

While the ecological dependence aspect of the domestication syndrome allows for a meaningful delineation of domesticated plants from wild, it is neither uniformly nor universally distributed among domesticated populations. Grafted fruit trees that have had fewer breeding cycles under domestication and have travelled only a little genetic distance from their wild progenitors are considered only partially domesticated (Janick 2004). Food plants that were previously domesticated and have since fallen out of cultivation typically revert to their wild form, and some major crops still retain aspects of their wild morphology even under intensive agricultural production. In these ‘recalcitrant’ domesticates, wildness and domestication are qualities that are coexisting, to differing degrees, within the same individual, yet the persistence of non-domesticated traits in domesticated populations features as an economic loss of agricultural productivity, and the retention of wildness sits at odds with the objectives of domestication. However, there are other ways and forms that wildness and domestication can coexist within the ambit of domesticatory practices. For instance, they are strongly interwoven through practices of cultivated seed conservation. Even though they are imagined as independent domains, the wild is an essential and active element in the continued survival of the domesticated. Domesticated species need a continuous influx of new genetic material to maintain their viability, particularly within the

¹⁹⁵ In some cases this characteristic was consciously selected, as with sorghum (Blumler & Byrne 1991).

monocultural environment where genetic uniformity leaves domesticates vulnerable to pests and diseases. Accordingly, strategies for conserving domesticated biodiversity are directed toward the conservation of wild relatives and traditional ‘landraces’, as well as modern cultivars, in temperature and humidity controlled environments of the *ex situ* gene bank. The reliance on wild genetic material for domesticated diversity even predates deliberate contemporary conservation efforts; a familiar example is the creation of modern bread wheat from the unintentional hybridisation of domesticated and wild cereal grasses.

A key act of early domestication was the initial selection of particular kinds and types of plants that met both the ecological demands of the field, and the time- and place-specific needs of human communities. This was a process that significantly narrowed the volume and diversity of food plants used and consumed by humans. As hunter-gatherers, humans had a diverse diet, and procured food from thousands of species. In a significant decrease, just 150 species are considered ‘commercially important’ in modern agricultural society, with only 103 species accounting for 90 percent of the world’s crops (Thrupp 2000).

The reduction in diversity that has particular significance for understanding that the wild/domesticated split is intra-specific, that is, it relates not to the diversity of species, but to the multiplicity of types occurring *within* the species boundary. As plants were brought into the *domus*, the unconscious and conscious selection of certain characteristics necessarily precluded the selection of other traits that were either detrimental, non-useful or neutral with respect to human purposes. Those plants that traversed the barrier between wild and domesticated represented only a small amount of the variety exhibited by the food species of a particular area. Among those species that were domesticated, only a limited number of actual plants and their progeny were subjected to the evolutionary pressures and opportunities of the fields rather than the forests or plains. In the initial stage of domestication under cultivation, domesticates are said to have passed through a ‘genetic bottleneck’. Cereal crops lost between 30 and 80 percent of the genetic variability that was held in wild populations (Gepts 2004). The original sample of genetic variability from wild species was narrow, it was reduced even further when selections of established crops were traded and transported across landscapes and away from their sites of original domestication. A relatively recent example of this kind of genetic reduction, known as the ‘founder effect’, is seen in the colonial plant transfers of the coffee crop. Although domesticated in Ethiopia, almost all the coffee plants that make up the South and Central American plantations are descendants of a single specimen taken from the Amsterdam botanic gardens in the eighteenth century. In turn, this tree was grown from a cutting taken from an Indonesian tree, which was inherited from Sri Lanka (then Ceylon), whose entire coffee production had been founded by the introduction of a mere seven seeds (Fowler &

Mooney 1990). The trend for increased genetic narrowness in domesticates was heightened considerably by the great number of such plant transfers through the channels of European imperialism. The domesticated sphere from its inception has been characterised by a much smaller pool of genetic diversity than its wild counterpart.

The association of the wild with the quality of diversity and domesticated with a lack thereof seems to run counter-intuitively. Domesticated species exhibit a notable array of variability. This diversity is visible, that is, it is displayed phenotypically. Genetic diversity may have decreased across the whole genome, but particular allelic sites that relate to colour, size, taste and other morphological traits have retained enough variability to give rise to multiple forms and diverse characteristics. Indeed, the survival of such divergence is directly reflective of a plant's domesticated status. For example, the brightly coloured fruits that characterise many domesticated plants – a result of either small genetic mutations or the out-breeding of one plant with an adequately dissimilar partner – was actively encouraged as a cultural and culinary preference. In the wild, the acquisition of bright or unusual colouring would either attract predatory animals and prove detrimental to a plant's survival or environmental selection pressures would be neutral toward the attribute of colour, and the occasional appearance would never make gains within the population. When sheltered from predation by its watchful human symbiont and actively encouraged by artificial selection, the colourful crop proliferates. Andean potatoes come in red, blue, black, white, purple and yellow. Running beans can be black, green, deep red, purple, yellow or speckled. Maize kernels come in an array of shades and combinations of four simple hues: white, yellow, red and purple/black (Warman 2003). Although the vivid red and blue kernels abundant in Native American maize varieties may not have been encouraged in a wild environment, the display of darker pigments is not antithetical to the plant's own purposes. It not only 'attracts' humans and ensures propagation, but warms the cob more quickly in the morning sun, marking the plant as an early maturing variety (Fowler & Mooney 1990). The range of other morphological variety within the single species of maize, or corn (*Zea mays*), attests to the extent of diversification under domestication:

[P]lant size...can range from three to thirteen feet in height. The period between germination and pollination can vary from 45 days to more than 150 days. It is possible that sometime in the past there were varieties that matured even sooner. The number of leaves on a corn plant can vary from eight to forty-eight and the number of ears, although almost always one per plant, can be double or triple that. An ear of corn can measure anywhere from four to twenty-four inches long, and the size of the kernels can vary tremendously (Warman 2003:14).

Differing starch content and textures gave indigenous farmers different ‘biotypes’ good for either boiling, roasting, popping, brewing or milling, as well as those that were best eaten fresh (Smith 1995). Across these varieties, the number of races¹⁹⁶ was estimated at 250 in Latin America alone¹⁹⁷. While the phenotypes of the domesticated realm reflected the diversity that protection and preferential treatment encouraged, this was not purely ornamental or culinary in scope. What is really valuable about diversity is the differential ecological fitness that place-specificity gives to types within the same species. As food plants were disseminated around the globe through human migrations, relocations and trade, they were introduced into new climatic, geographic, entomological and agroecological locations. Their success in these environments relied on their timely acquisition of new genetic material and the creation of new genetic combinations. Through chance genetic mutations, interbreeding within the crop population, and out-crossing and hybridising with established species, introduced crop plants were able to become biologically accustomed to the area, and to its pests and diseases.

The adaptation of crops to new climatic zones was also facilitated by the domesticatory practices of the area. As partial agriculturalists, the Apache Amerindians would stop to plant their maize in the spring, returning for the harvest after a summer of nomadic hunting and gathering. This cultural pattern converged with selected-for, hardy, drought-tolerant types that could survive the hot, untended summers (Smith 1995). The specificity of such adaptations, and their creation of distinct and stable varieties, was made possible by their geographic isolation from their parental and related stock. The place-specificity of intra-species diversity is particularly marked in mountainous areas where winter crossings are near impossible. Without the conditions to support seed exchange, crops would develop differentially according to the selection pressure of each community’s arbitrary needs. The diversity of domesticated plants generated under mass selection, unlike under natural selection, has been retained because it has been useful for different humans in different times, places and circumstances. There are some 5000 varieties of potato in cultivation, differing in taste, size, shape and colour (Fowler & Mooney 1990). It is estimated that there were over 30,000 varieties of rice grown in India last century (Morin *et al.* 2002). Wild populations of crop progenitors and relatives retain a substantially more diverse gene pool than domesticated crops, but the many millennia of phenotypic diversification under

¹⁹⁶ A race is comprised of ‘individuals with enough characteristics in common to permit their recognition as a group within the larger classification of species’ (Smith 1995: 8).

¹⁹⁷ In modern farming only six varieties are important in the commercial market: flour corn, waxy maize, sweet corn, popcorn, flint and dent (Smith 1995).

domestication appears to bestow the generic quality of ‘diversity’ as much to the domesticated realm as to the wild.

Appearances are not reliable in this case, though, and the narrow genetic base of domesticated plants, which is becoming increasingly smaller as modern crops continue to displace traditional varieties around the globe, has real implications for their ongoing viability as robust organisms in the agroecology (Plunknett & Horne 1992). In order to keep pace with the spread and evolution of pests and diseases, and to survive environmental fluctuations, domesticates must continue to evolve. A smaller pool of genetic diversity with which to do this means that domesticated varieties, particularly when grown in large monocultures, are far less environmentally resilient than the same species in the wild. Coffee rust (*Hemileia vastatrix*) spread through the very small gene pool of coffee plants to devastate production in Ceylon (Sri Lanka), India, East Asia, and parts of Africa in the 1870s (McCook 2006). The potato fungus (*Phytophthora infestans*) arrived in Ireland in the 1840s to destroy entire fields of the nutritious non-market subsistence food crop that had the genetic base of a single variety of potato. Approximately one million people died of starvation in the famine that followed (Gepts & Papa 2002). The massive American corn blight losses of 1970 resulted from the genetic uniformity of these modern cultivars that left them vulnerable to infection by *Helminthosporium maydis* on a massive scale (Ullstrup 1972). The production benefits of genetic uniformity are too valuable to abandon in response to the ecological deficiencies of the narrow genetic base. Instead, the solution is sought in the continuous development of new commercial varieties, *via* the supply of fresh genetic material provided through crop variety conservation programs. Resistance to such diseases is found in the genetic diversity of the wild, in the full range of diversity of the species that is held in folk varieties and wild ancestors and relatives. “The function of wilderness...thus becomes obvious. Wilderness is an investment in a biological currency we cannot specify, a hedge against a biological need we cannot name” (Ghiselin 1974, in Plunknett & Horne 1992: 79). Resistant, tolerant, protective, and as yet unknown traits possessed by landraces, old varieties, and wild and weedy relatives of crop plants are routinely bred into cultivated varieties to protect the ongoing viability of domesticated species in the field.

Wildness as diversity

The relationship of dependency between domesticated, wild and less domesticated plants is not an anomalous development but has been an inherent element of domestication since it first encountered the genetic bottleneck. This relationship belies the mutual exclusivity of wild and domesticated categories, and presents a challenge to the certainty of the boundary

between the two kinds of nature. In the institutional environment of the *ex situ* seed bank, the wild is now brought into the domus to provide the genetic material for future plant breeding efforts. Domesticated varieties need to be protected against their extinction in cases where they fall out of use, and the singularity of the project to conserve domesticated varieties and their wild relatives has been recognised at least since the pioneering botanical collecting expeditions and seed conservation efforts¹⁹⁸ of Russian Nikolai Vavilov (1887–1943). Wild and landrace plant seeds are now routinely collected and stored in refrigerated environments in response to their continuing erosion from the fields of farmers and from the wilderness areas where they exist in a wild form. Wild progenitors of food-bearing plants are threatened by loss of habitat from land clearing for settlement, agriculture and industry, while landraces created by thousands of years of mass selection by farmer-breeders have been, and are increasingly being, abandoned in favour of new scientifically-bred and now biotechnological varieties¹⁹⁹.

The Food and Agriculture Organisation (1996) has estimated that three-quarters of cultivated varieties had been lost in the previous 100 years. Wild crop relatives that are currently nearing extinction are the soybean in China, the tomato in South America, coffee in Africa, hard wheat in Turkey, and grapes in America (Department of Agricultural Sciences 2002). In China, the nearly 10,000 wheat varieties that were in use in 1949 were reduced to 1000 by the 1970s (FAO 1996). In 1903, there were 578 varieties of garden bean listed by the US Department of Agriculture (RAFI 1982 in Fowler & Mooney 1990). Eighty years later this number had been reduced to 32. In the same period, 7098 pear varieties were reduced to 977. One of the now extinct varieties is described by a fruit expert:

In particular, the flesh is notable, and is described by the term *buttery* ... rather better than that of any other pear. The rich sweet flavour, and distinct but delicate perfume contribute to make the fruits of highest quality... [it] should find a place in every collection of pears for home use (Hedrick 1921, in Fowler & Mooney 1990: 63, original emphasis).

The loss of diversity is clearly a culinary as well as agronomic tragedy, but the imperative for crop plant conservation is not to keep such old varieties under cultivation for consumption. Concern about the loss of folk varieties relates primarily to their capacity to

¹⁹⁸ Vavilov's expeditions were undertaken as part of his systematic identification of agricultural geographic origins. In the United States, Jack Harlan (1917–1998) became well known for his plant collection expeditions and advocacy of the importance of genetic diversity in agriculture. Both Vavilov's and Harlan's collections motivated the establishment of international long term seed collections (Gepts 2004; McCouch 2004; Wilson 1997; Evans 1993).

¹⁹⁹ Details of the loss of folk varieties is hard to measure because the varieties have not been catalogued and recorded before their loss (Cleveland *et al.* 1994).

provide raw material for breeding (Cleveland *et al.* 1994). Neither is it to maintain wild progenitors in park-like reserves, although, beyond the unambiguously artificial settings of gene banks, there exists such spaces as the Plant Genetic Resource Unit collection of apple varieties in Geneva, New York (Pollan 2000: 60). This tidy orchard contains over 2500 varieties of cultivated apples, including two long rows of wild apples collected from their centre of diversity in Kazakhstan:

None of these trees looked remotely alike, not in form or leaf or fruit. Some grew straight for the sun, others trailed along the ground or formed low shrubs or simply petered out, the upstate New York climate not to their liking. I saw apples with leaves like those of linden trees, others shaped like demented forsythia bushes. Maybe a third of the trees were bearing fruit – but strange, strange fruit that looked and tasted like God’s first drafts of what an apple could be.

This image of decidedly undomesticated apples assembled in neat orchard rows in service to their domesticated relatives is a visual reminder of Thoreau’s observation that ‘in wildness is the preservation of the world’. Given the energy and infrastructure that goes into the establishment and maintenance of such orchards, albeit a fraction of what is required for operational gene banks, this image also references Wendell Berry’s (1987) amendment that the preservation of the world may lie in wildness, but the preservation of wildness lies in human culture²⁰⁰. To this, Pollan (2001: 63) reflects on the significance of planting just one of these wild apple trees in his own garden:

[i]n the middle of a garden – in the middle of a landscape, that is expressly designed to answer our desires – what such a tree will mostly bear is witness to an unreconstructed and necessary wildness ... There can be no civilization without wildness, such a tree would remind us, no sweetness absent its astringent opposite.

From this history of domestication, a very broad conceptual delineation between the wild and the domesticated can be drawn along the lines of diversity; simply, increased domestication equates to reduced diversity, and retained wildness to retained diversity. The heavy use made of domesticated diversity in traditional and contemporary polycultural agricultural systems underlies the claim of these systems to naturalness and their self-identification as sustainable agriculture. These systems are differentiated, *inter alia*, from industrialised, monocultural agriculture by the intra- and inter-species diversity of their domesticated plants and animals, and the protection from pests and diseases that such design

²⁰⁰ Given the traditional location of wildness in wilderness landscapes completely uninhabited by humans, Berry’s observation relates in particular to the central role that human activity has in the maintenance of wilderness areas, which now survives almost entirely in artificially-bounded parks and reserves.

affords²⁰¹. Agrobiodiversity in the field is agronomically valuable because it recreates the ecological robustness of wild systems (Thrupp 2000), and is philosophically valuable for its retention of wildness *qua* diversity in the domesticated domain. Polycultural systems are, understandably, labour intensive²⁰², and so also broaden the site of engagement between humans and nature through agriculture and domestication. Ecofeminist defences of such systems and the positive role they play in both maintaining life in traditional and urban societies (Mies & Shiva 1993; Mies & Bennholdt-Thomsen 1999), and fostering ecological sensibilities (Salleh 1997), also reframe labour intensive agriculture as a benefit and not a loss for culture. Traditionally, the reduction of the agricultural labour force²⁰³ through industrialisation has been appreciated uncritically as ‘progress’ that has relieved us from the demeaning and back-breaking work of tending fields. Polycultural production affords an affirmative view of agricultural labour in which its small scale, diverse and interesting tasks are thoroughly unlike those required for manually harvesting a monoculture (Mies & Shiva 1993; Mies & Bennholdt-Thomsen 1999). To the extent that genetically engineered solutions are targeted at monocultural problems of production and genetically engineered crops are designed to be grown in monocultural conditions, adoption of the technology in agriculture represents a consolidation of monocultural environments as the primary domesticated landscape. Genetic engineering is a homogenising force compared to the diverse wildness of life that is able to be retained in the agricultural context as domesticated diversity. The same biotechnological varieties are developed to be grown across the globe, so that the local cultural and climatic differences historically responsible for the intra-specific diversity of traditional varieties no longer feature in their ongoing evolution²⁰⁴.

Recognising the retained wildness of domesticates in the inter- and intra-specific diversity of agricultural systems, and regarding this positively as an environmental value, adds further weight to the claims of these systems to naturalness *qua* environmental sustainability, beyond pollution reduction and containment. This positive association between diversity and naturalness is also reflected in presentations of biotechnology as a method of increasing our potential to generate agrobiodiversity (Angermeier 1994). As it can theoretically combine genetic material from any number of organisms into new plants, it is regarded as an

²⁰¹ Some information about this, including acknowledging that it is problematic to call particular designs definitively ecological.

²⁰² They are also more productive, producing 100 units of food from units of input, compared to 100 units of food from 300 units of input in oil and chemical-intensive monocultural production (Shiva 2000b).

²⁰³ In Australia, 40 percent of the working population was employed in agriculture in 1900, compared to 4.4 percent in 2000 (ABS 2000). Similarly, agricultural employment in the USA declined from 50 percent to 4 percent of the workforce between 1870 and 1970 (Williamson 2004).

²⁰⁴ Hence, there is a strong argument for the *in situ* conservation of traditional varieties in the areas that they have evolved (Falcon & Fowler 2002; Cleveland *et al.* 1999; Bowen 1999; Wood & Lenne 1997).

important tool for conservation in the context of the global entrenchment of monocultural practices, and the replacement of traditional varieties by commercially bred crops. The artificial diversity it generates is not for the agrobiodiversity within one farm, but for the overall diversity from which new commercial varieties can be developed. In a similar vein to the invocation of evolutionary change to justify anthropogenic change, biodiversity is regarded as a generic natural good that can be increased by genetic engineering. Yet even if this qualifies the technology for the preservation of wildness *qua* diversity, it falls short on another, related, understanding of this wildness: the fundamental mindlessness of evolution and the indeterminacy of the diversity that it generates. Here remains, even under conventional domestication, an indeterminate element to the kinds of forms that are generated. In answer to the narrowness of narratives of domestication and evolution as unproblematic natural change to be used as precedence for all anthropogenic change, the next section looks to the process of domestication *qua* artificial evolution in terms of the retention of the ‘wild’ evolutionary quality of indeterminacy.

Wildness as indeterminacy

A key quality of the domesticatory relationship is one that is more closely shared with evolution proper, that of the indeterminacy of the outcome of any evolutionary process. In evolution under domestication, blind natural selection is substituted by thoughtful, artificial selection but, as has been shown in the previous chapter, the inability to plan and predict the exact results of domestication has limited the impact of human design and left a significant role for uncertainty, serendipity and circuitousness. The immense amount of site-specific diversity generated under domestication by the evolutionary mechanisms of variation, transmission and selection²⁰⁵ throughout domesticatory history was not foreseen or

²⁰⁵ Organisms change and evolve through the three-fold process of variation, natural selection, and transmission. Variation within a particular species results from random genetic mutations that occur at the rate of about one for every 100,000 organisms. Not all of these mutations are particularly useful, and if an organism doesn’t survive to pass this variation on to the next generation such changes are lost. The potential of survival is increased when the mutation works to benefit the organism. Benefit is determined by the extent to which the organism is able to ‘fit’ into its direct environment and successfully navigate the surrounding ecological forces. From the genetic variation that emerges in a population, particular phenotypes will be more successful than others, and may confer qualities that increase their ability to evade predators, secure food and water, or protect their young, all of which increase that form’s chances of survival. The third phase in the process of evolution – transmission – refers to the biological fact of heredity, where successful mutations are passed on and endure to make up the phenotype of following generations. Evolutionary theory works with a certain model of the qualities of the natural world. The organism itself is not a discrete, unyielding whole, but a collection of adaptable individual traits and characteristics. The environment of the organism is instead relatively fixed. The climate, the weather, the geological, mineral and chemical conditions, and, importantly, the ecological interactions with other organisms, comprise the environment of the organism, and all exert selection pressure upon it. Selection pressure is seen in the effect that it has on the whole gene pool of a population of organisms. Simply, forms and qualities that are more suited to survival in the surrounding, relatively stable, environment will make up more of the gene pool of that species in that area. When this process takes place over very long periods of time, the place-specific diversity that results can lead to the development of entirely new species (Rieseberg *et al.* 1999).

foreseeable but largely indeterminate. Although the quality of indeterminacy has been progressively reduced as the scientific knowledge of heredity has been increased and systematically applied to the goal of achieving more precision in plant breeding, indeterminacy nonetheless remains a distinguishing feature of domestication. It is seen in the unpredictable effect of many millennia of short term selection on long term outcomes in the generation of farmer selected diversity. Domestication has not entailed a straightforward evolutionary change in one direction, rather, “natural and cultural evolution take place in the immediate environment and not in terms of long-range, orthogenetic, inevitable outcomes” (O’Brien & Wilson 1988: 961). Domestication was “the cumulative effect of individual actions and subsistence choices over many generations.” (Terrel *et al.* 2003: 333)²⁰⁶. Further, beyond the unconscious, undirected selection of early domestication, random genetic mutations and the inexactness of sexual reproduction continue to produce unplanned genetic variation, even under the strictest breeding programs. To the extent that domesticated plants resist a level of intentional design it can be said that they have retained the quality of indeterminacy, and thus some of their original wildness. Even the agricultural requirement of continuous evolution under domestication (in order to protect crops from evolving pests and diseases by conserving food plant diversity in local and global seed saving efforts) must cater to indeterminacy. Exactly what genetic material will be needed from these vast stores, and at what times, is indefinite.

Indeterminacy is identified as a conceptually and ethically valuable quality of evolution in the work of Elisabeth Grosz (1999) and her argument for a positive feminist consideration of Darwinism. For Grosz, Darwin’s model of the mindless generation of diversity and selection of forms²⁰⁷ signals a rejection of essentialism and teleology that runs contrary to the common use of evolutionary theory to justify oppressive social conditions in particular forms of social Darwinism. Grosz argues that evolutionary theory provides feminism with the conceptual tools to theorise and realise non-dominating social relations, where the current social environment is conducive to their selection. Just as indeterminacy and uncertainty run contrary to gender essentialism in Grosz’s model, they are also the antithesis to the goals of engineering, and genetic engineering specifically. Instead of emerging through random mutations and wild hybridisations, variation is now deliberately generated by genetic engineering techniques (Gepts 2002). An abhorrence of genetic engineering as the total design of otherwise natural objects, which for Lee (1999) stems from the loss of the

²⁰⁶ See the discussion of the role of unconscious selection in domestication in Chapter Five (pp. 140-152).

²⁰⁷ Grosz (1999: 39) describes evolution as “a fundamentally open-ended system which pushes towards a future with no real direction, no promise of any particular result, no guarantee of progress or improvement, but with every indication of inherent proliferation and transformation”.

ontological category of independent, non-artefactual nature, is also traceable to the loss of the valued (wild) quality of indeterminacy. In this reading, it is indeterminacy that is the relevant standard and valuable quality of evolution (under domestication) in the face of its circumvention by biotechnological interventions, not arbitrary change or the erasure of boundaries separating species. The normative appeal of evolution for environmental ethics ought to be the connection between natural objects and their production through evolutionary processes (Preston 2008), not the precedent it sets for change *per se*.

The value of indeterminacy is expressed slightly differently in Adorno's (1997: 74) observation that the dignity of nature lies in 'the not-yet-existing'; in its generative capacity, which 'repels intentional humanisation'. Indeterminacy and the not-yet-existing offer conceptualisations of wildness in terms of a future orientation, as the expansive potentialities and possibilities that are inherent in the fact of the ongoing evolution of natural forms. Indeterminacy in domesticated nature is eroded by the overdetermination of domesticated forms represented by genetic engineering, and also by the future-limiting political and economic arrangements that accompany (and indeed facilitate) the technology. The global spread of biotechnology crops at the expense of locally grown and continuously evolving varieties, the further consolidation of smaller farms into much larger acreages, and the insistence on *ex situ* in favour of *in situ* conservation solutions strip evolution under domestication of its cultural and site-specific differences (Wood & Lenne 1997; Stacey *et al.* 1999; Greene & Morris 2001). Unprecedented exclusionary rights over food seed through intellectual property regimes, the limits these place on traditional farmer seed saving practices, and the growing ubiquity of genetically modified crops in the food chain all work to narrow the future potentialities for domesticated evolution. The scope of the 'not-yet-existing' value of domesticated nature depends on the continuation of diverse cultural, agricultural and environmental conditions, and the availability of diverse seed stocks. Respecting the 'wild' indeterminacy of domesticated nature entails a measure of opening up agricultural possibilities that runs contrary to the modes of agricultural production required by the contemporary global agrarian market.

Wildness as otherness

The third possible form for wildness that is advanced in this chapter is derived from the already established understanding of wildness as independent, autonomous and self-willed. To the extent that nature is different from, and indifferent to, humans and the human world, it is definitively 'other' to humanity. Otherness inhabits a spatial location in the perspectives, priorities and bodies of nonhuman organisms. It is, in the face of the extensive conceptual problematisation of the category of nature, the wildness we have in evidence that

nature is not a social construct (Hay 2002). Like the wilderness landscape itself, wildness as 'otherness' is valuable precisely because it tells our absence. It is wild otherness that is valued in Eric Katz's (1993, 2002) insistence that nature ought to be devoid of anthropogenic origins, and is protected in Keekok Lee's (1999) stand against the replacement of independent with artefactual nature. An appreciation of nonhuman otherness is well established in the field of environmental philosophy (Birch 1990; Evernden 1992; Elliot 1997; Hailwood 2000; Plumwood 2002). *Contra* the strong identification with nature that underlies deep ecological approaches of emphasising commonalities and seeking a kind of selfhood in nature, the value of nature is argued to be derived from its otherness (Dion 2000; Hailwood 2000; Plumwood 2002). The experience of otherness in nature has been described as a necessary element for human growth; we can understand ourselves better by being aware of what we are not (Oelschlaeger 1991; Evernden 1992): "[t]he other reveals the self" (Evernden 1992: 112). It is similarly argued that, when humans "confront, honor, and celebrate the 'other'", they cultivate the (environmental) virtue of humility (Hettinger & Throop 1999). Importantly, nature's otherness is valuable because it is independent, autonomous and self-willed. We are not responsible for its creation, and "[p]eople value being a part of a world not of their own making" (Hettinger & Throop 1999).

Cronon (1996: 87) contends that the way we can "take the positive values we associate with wilderness and bring them closer to home" is by "broadening our sense of the otherness that wilderness seeks to define and protect". The wilderness experience offers an unambiguous experience of otherness. Otherness is less evident, say, in one's own garden, but a single tree in the remote forest is no more 'other' to us than a tree in the backyard, even though it is implicated in many more complex ecological relationships:

Both trees stand apart from us; both share our common world ... Both trees in some ultimate sense are wild; both in a practical sense now depend on our management and care. We are responsible for both, even though we can claim credit for neither (p. 89).

Wildness as otherness ultimately accentuates, rather than contradicts, the traditional mutual exclusivity of wild/domesticated. Insofar as (the genetic effect of) human activity is the defining element in the construction of nature as either wild or domesticated, wildness is simply that which lies beyond the frontier of human's domesticating practices. Thus, Neil Evernden (1992: 120) writes:

Wildness is not 'ours'—indeed it is the one thing that can never be ours. It is self-willed, independent, and indifferent to our dictates and judgments. An entity with the quality of wildness is its own, and no other's. Where domestication ends, wildness begins.

In other words, “something is wild in a certain respect to the extent that it is not humanised in that respect. An entity is humanised in the degree to which it is influenced, altered or controlled by humans” (Hettinger & Throop 1999: 12). In domesticating nature, we make it ‘ours’, a sentiment that is epitomised in the idea of domesticates as biotic artefacts. Those aspects of domesticated nature that resist domestication – through the retention of some wild morphology, or simply through the persistence of their pre-existing botanical form – do not become ours but remain their own. In Evernden’s analysis, the line between wild and domesticated is redrawn at the scalar level of the organism, rather than the traditional level of the landscape. Plant traits that are taken to be consistent with wildness as otherness could thus persist in any botanical entity that, on its own, strives to grow, flourish, procreate, seek sunlight and water, and, importantly, retain material and biological primacy in its production as a domesticated artefact. The very specific botanical form and tendencies of plants stands as an ‘otherness’ to humans and human intentionality. The seedless grape, an epitome of biotic artefactuality in that it can no longer reproduce independently, is rescued from categorisation as pure artefact by an appreciation of this primacy, by an appreciation of its otherness (Sperber 2007). This otherness is grasped in the responsiveness of the grape to the artificial selection pressure of fruit-loving mammals willing to propagate the vine vegetatively, the independent evolution of its material offering of form and substance that preceded and continued under domestication, and its existence as a Taylorian ‘teleological centre of life’ that continues to exist *for itself*, if not *by itself*.

Respect for the otherness of domesticated plants is a central tenet of the principles of organic plant breeding (Lammerts van Bueren 2001; Rehmann-Sutter 2001; Lammerts van Bueren *et al.* 2003; Verhoog 2003; Lammerts van Bueren & Struik 2005). In emphasising the otherness of the domesticated plant, Christoph Rehmann-Sutter (2001: 10) points to the biological form and the reproductive barriers of domesticates, and contends that human domesticatory practices alone “cannot change a plant. It is the plant that allows the changes”. Genetic engineering, on the other hand, is not respectful of this otherness. For Evernden, respect for the wild otherness of domesticates comes in the form of leaving some part of them undomesticated. Understood as the farthest possible physical extension of domesticatory practices, biotechnology is thus charged with committing “the *domestication of the gene*, the final assault on the wildness of life” (1992: 120 original emphasis). Evernden’s undomesticated gene is a source of valuable otherness in the world, a conceptual and material place where nature has escaped humanisation. Where traditional domestication affects, but otherwise preserves, this otherness (as with the seedless grape), the genetic engineering of domesticates represents its erasure:

The domestication of the gene exterminates wildness at its source and places all life within the domain of human willing. Nature is domesticated in body, in concept, and finally, one must say, in spirit (Evernden 1992: 120).

Under the total domestication of nature, domestication becomes the creation of narcissistic objects, and only humans and their artefacts are left in the relationship (Lee 1999). Otherness, necessarily a relational quality that implies us (or, in the case of the wild/domesticated dichotomy, domesticated nature) to be other to, ought to be preserved in our domesticatory dealings. As long as the history and process of domestication to date continues to be narrowly understood by environmental ethics as a disvalued, other-denying relationship of domination, such a differentiation between traditional and biotechnological domestication is not able to be made. Accordingly, a reconceptualisation of domestication as a long term ecological relationship that can offer a way to recapture and appreciate the otherness of domesticated nature is offered in the following and final chapter.

Conclusion

In answer to the long-standing treatment of domesticated nature as a source of disvalue – and its attendant exclusion from the scope of environmental ethics theories of natural value – this chapter has built on previous associations made between particular elements of domesticated nature and the quality of wildness. The wild and the domesticated are commonly understood as mutually exclusive, but they are strongly imbricated categories. In the first instance, domesticated nature is highly dependent on wild nature for the ongoing genetic diversity of the agricultural field. The narrow genetic base of domesticated plant populations makes them highly vulnerable to pests and diseases, particularly in the monocultural production model in which they are grown. Without frequent genetic input from wild and less-domesticated relatives, domesticated varieties would not continue to survive. Far from being the independent, artificially-sustained realm that it is imagined, the domesticated is still very much contingent on the material contributions of the wild.

Existing scholarship on the separation of the quality of wildness from the landscape of wilderness, and the subsequent recognition of the persistence of wildness in other landscapes, prefigures its recognition in domesticated nature and supports the identification of three distinct kinds of wildness in domesticated plants. The first rests on an association between wildness and diversity based on the relatively high level of genetic and species diversity of wild nature as compared domesticated nature. The value attributed to wild genetic variation is also seen in the extensive variation displayed by domesticated plants, which has been generated under the long term, culturally, geographically and climatically diverse history of domestication. The agronomic value of domesticated diversity is well

recognised and its conservation is an agreed global priority. There are, however, significant differences between *in situ* on-farm and *ex situ* 'gene bank' models of conservation. Broadly speaking, *ex situ* conservation maintains the agricultural *status quo* with respect to large-scale monocultural production, while *in situ* conservation retains the possibility of preserving traditional and polycultural smaller scale models, and the particularised local cultural contexts under which the evolution of domesticated diversity can continue. Just as wild biodiversity underlies the robustness of ecological systems, agrobiodiverse polycultural systems are more resilient to external environmental impacts. They also require more labour input. The political dimensions of a more diverse (or wild) agriculture are taken up in ecofeminist writings on the unrecognised value of labour intensive over chemical or mechanical intensive agriculture. Subsistence labours are valued for their potential to grant independence from the global agricultural market as well as for the environmental sensibility that comes from undertaking work that is embedded in nature and ecological processes. Valuing the quality of wildness *qua* diversity in domesticated nature tells against agricultural genetic engineering in the sense that it represents the consolidation of large-scale monocultural modes of production, and in favour of modes of agriculture that reflect an ecofeminist politics.

The second sense in which domesticates can be considered to have retained wild characteristics is with regard to the evolutionary process of variation, natural selection and transmission. This sense of wildness is offered as a partial resolution to the soritical recourse to the fact of evolution in presentations of genetic engineering and domestication as morally equivalent. The emphasis in these evolutionary narratives is on change *per se*: organisms in general – and species in particular – are genotypically and phenotypically changeable. In a bid to shift away from natural evolutionary change as the legitimising basis for anthropogenic change, and, indeed, from previous anthropogenic change as the precedent for all future such change, this chapter brings a different aspect of evolutionary change to the fore. The ethically significant feature of evolution is the *indeterminacy* of the changes that it brings about. Most of domesticatory history has shared the natural evolutionary quality of indeterminacy. Key domesticated ecological traits were unconsciously selected for in the agricultural field; the long term effects of consciously saving and replanting plants with particular characteristics each year was unforeseeable; and even where scientific knowledge and technical ability permitted greater control over breeding outcomes, these were not certain or predictable. The DNA recombination method can generate genetic variation to the specifications of the selector and allows for near total determination of a plant's characteristics. Indeed, its triumph over indeterminacy is one of its marketed strengths. The political economy of biotechnology also ensures significant consolidation of

large scale, mechanised, corporate-dominated agriculture and, with the added expansion of property rights over crop seeds, the resulting restrictions on small and traditional farmers do much to close down the social and economic indeterminacy of agricultural futures.

An appreciation of wildness *qua* the indeterminacy of evolutionary outcomes places value on the serendipity, autonomy, and self-willed processes of nature. A conceptualisation of wildness *qua* otherness values nature for similar reasons, but where indeterminacy relates to processes, otherness is an embodied quality of nonhuman organisms. Applying the already established synonymy of wildness and otherness to the case of domesticated nature does reinforce, rather than repudiate, the traditional mutual exclusivity of wild/domesticated dualism. However, it allows for the dividing line between the two categories to be redrawn *within* the organism, rather than at the level of the landscape. Thus, we can speak of otherness as existing within domesticates, both as nonhuman biological entities and to the degree that they escape total artefactuality. To the extent that the domestication of the gene represents a new level of loss of wild otherness in domesticated nature, an ethic that protects and conserves wildness provides a way to critique the adoption of genetic engineering technology in agriculture.

Diversity, indeterminacy and otherness are forms of wildness retained under domestication that stand as a source of natural value in the face of the biotechnological modification of domesticated nature. These formulations – in particular that of otherness – admit the possibility and the undesirability of the elimination of wildness. Further, the recognition of retained wildness has implications for the traditional understanding of domestication as the domination of nature: recognising that there are degrees of wildness under domestication must also admit that there are degrees of domination. Yet it is a mistake to conceptualise retained wildness – or, indeed acquired domestication – in quantitative terms, or to assume a mathematically linear relationship between the two qualities. The partial humanisation of nature is not merely proportionally less undesirable than its total humanisation; the devaluing effect of domestication does not aggregate as an arithmetic series. Indeed, the relationship between wildness and domestication within the organism is decidedly permeable and non-linear. The domesticate is valuable as a wild entity, as a human artefact *and* as a heretofore unspecified permutation of both. A review of the human-nature dynamics of the domesticatory relationship must pay particular attention to this combined value. The next chapter builds on the recognition of domesticates as an assemblage of wild and domesticated qualities, and responds to Cronon's critique of the wilderness concept and subsequent calls from within environmental ethics to affirm a place for humans within nature, by turning to the task of articulating the relationship of domestication in positive terms.

Chapter Seven

Relationship: toward a relational appreciation of domestication

Introduction

This chapter offers a positive articulation of the domesticatory relationship in environmental ethics terms. It progresses elements of environmental thought shown to be instructive in previous chapters through synthesis with domestication scholarship from further afield. In recognition of the retained wild qualities of domesticates, and in contra-distinction to the severe ontological framing of domestication as the production of disvalued human artefacts, it is argued that domestication is understandable in relational terms that emphasise its collaborative aspects. This approach to domestication also serves as a response to calls from within the field for formulations of positive, affective, human relationships with nature. It offers an environmental ethics adjunct to ecofeminist relational accounts of the political elements of domestication and biotechnology, and deepens the environmental ethics contribution to understanding the consequences of biotechnology for the human relationship with nature.

An appreciation of the wildness of domesticated nature, shown in the previous chapter to offer a number of prospects for a defence of domesticated nature against biotechnological modification, presents a challenge to the traditional environmental ethics vision of domestication as a totalising process of domination. The identification of gradations of retained wildness in domesticates suggests the existence of similar gradations of domination. If the decidedly anthropocentric good of plentiful, flavoursome food need not be equated with the degradation of the intrinsic value of wildness, the recognition of the retained wildness of domesticates might offer a way to reconcile the instrumental and intrinsic value of domesticated nature. Revision of the domesticatory relationship in more positive terms attempts to preserve the wild other while still commemorating the benefits of the instrumental use of nature. This entails a move away from an overarching concern with determining the ontological and axiological 'status' of nature and toward an appreciation of domestication as a relationship with an other, specifically, as a coevolved people-plant relationship.

This move is underwritten by recent neo-Darwinian revisions of the dynamics of early and ongoing domestication. This scholarship upsets the traditional understanding of domestication as a domineering, one-sided affair and presents alternative models of domestication as an emergent coevolutionary relationship. It tends to emphasise commonalities between the human domestication of food plants and animals and other mutualistic relationships between organisms of different species in wild nature. Framing domestication in the terms of evolutionary ecology instead of as a principally culturally-driven set of activities has a number of effects. First, it blurs the distinction between the previously unproblematic categories of natural (hunter-gatherer) and cultural (agricultural) subsistence strategies. It presents a challenge to the vision of agriculture as necessarily revolutionary that has allowed it to be identified as the cause of human conceptual and material alienation from nature, and that has underpinned the representation of biotechnology as merely one more intervention in a series of unnatural interventions. Secondly, in treating both sets of organisms in the people-plant relationship with some measure of equivalency, the coevolutionary framework highlights the ecological benefits of domestication for food plants. Their participation in domestication and their production of generous yields is understandable in terms of their responsiveness and adaptability to the environment rather than their acquiescence to a greater force.

Thirdly, a coevolutionary perspective on domestication pays attention to the mutually affective roles of both humans and plants. Like other evolutionary and ecological narratives, it is an important way into an environmental ethic “because it demands from us our accountability to material reality and ... grounds our environmental norms” (Preston 2001: 253). It also provides a framework for appreciating how humans have both produced and been produced by the processes of domestication. It is sensitive to the impact that the specificity of plant characteristics have on human practices, economies and institutions. Although the respective contributions of plants and people to domestication are asymmetrical in intent and extent, the affect of plants is as significant a feature of domestication as the genetic changes that humans have wrought in plant populations. Recognising the causal power of the botanical form in the domesticatory relationship provides a way of tracing the alterity of domesticated organisms. The autonomous experience, tendencies and inherent constraints of the other make domestication a collaborative production, and domesticates themselves somewhat hybrid objects of human and plant objectives. A positive domesticatory relationship that respects the wildness of nature while maintaining its instrumental use represents a conceptual move away from Plumwood’s sphere of use/sphere of reverence dualism. It is other-acknowledging; it affirms this hybridity *and* protects the retained otherness of domesticated plants from excessive

humanisation. From this relational perspective of domestication, the technology of genetic engineering diverges from the collaborative approach and presents as an other-denying practice. It epitomises a way of knowing that configures the world as an aggregate of objects rather than as subjective others, and sustains this epistemology through the attendant consolidation of commodifying interests in domesticatory practice. The bi-directionality of domestication, and the established value of encountering otherness as necessary for self-realisation, means that this diminution of nature is collectively experienced.

Domestication as relationship

Recent scholarship on domestication – from technical accounts in archaeobotanical, archaeozoological and evolutionary ecological literature, to critical consideration of domestication practices and their effects in geographical, cultural, environmental historical and animal studies²⁰⁸ – traces the richness of these interspecific relationships. Advancement in DNA mapping and recognition technologies has made the archaeological record more accessible, and there has been a dramatic increase in the number of technical publications on domestication and the origins of agriculture over the last decade (Ross-Ibara 2005). Outside this field, domestication has not been subject to much critical attention prior to recent interest in biotechnological developments and the relative naturalness of domestication as an importance factor in the acceptability of genetic engineering technology. The unofficial grouping of inter-disciplinary scholarship that are loosely termed ‘domestication studies’ has nevertheless made valuable contributions to building an understanding of the dynamics of domestication. These works variously emphasise the importance of the inherent qualities of plants and animals and the complexity of domesticatory exchanges and their human causes/effects. They also draw attention to the need to develop comprehensive and generous ethical theorisations of domestication.

Geographer Kay Anderson (1997: 464) has observed a prevailing academic silence on domestication that “is not only surprising but also one that continues to constrain the imagining of alternative ethical and practical relationships between humans, animals and environments”. The main barrier to an environmental ethics contribution to this project has been the framing of domestication as a source of disvalue by leading ethical theories²⁰⁹.

²⁰⁸ In the non-technical literature there is a strong focus on animal domestication. The ethics of animal husbandry in the context of large scale industrial food production has had, and arguably should have, a dominant role in critical assessments of domestication practices. With its particular focus on domestication rather than welfare, this work does generate useful insights into the dynamics and significance of the domesticatory relationship, relevant to critical discussions of plant domestication.

²⁰⁹ As presented in Chapter Three.

These tend to focus on ethical interactions with wilderness landscapes, and advise leaving such places alone *via* the broad proscription of human interference in nature by intrinsic value theory. This approach has precluded the conceptualisation of an optimistic human relationship with nature. While the dissuasion of human interference is important to the project of protecting discrete areas of wild nature, the ‘dark side’ of the prominence of wilderness and wilderness issues in environmental ethics is the corresponding lack of an affirmative role for humans in the natural world (Hettinger 2005). This represents a gap in the scope of environmental ethics, which has been critiqued by a range of other authors in the field; notably Ned Hettinger (2002, 2005) on the need for a positive human role, Andrew Light (2001) on the expansion of the field to include urban environments, William Cronon (1996) on the limits of the wilderness concept, Roger King (2003) on the inclusion of domesticated spaces, and Warwick Fox (2006) on the synthesis of environmental and broader ethics into a General Ethics.

Any positive treatment of domestication would need to critically revise the doctrine that human interference is always a loss for nature and give more consideration to the subtle gradations and effects of different kinds of human presence in nature. In seeking a way forward for our ‘constructive co-habitation with other creatures’, Ralph Acampora (2004) suggests one model that may be useful for making this distinction. His conceptual spectrum traces a range of interventions through increasingly intensive modes of human ‘presencing’ in nature. To begin, the true wilderness only comes into human awareness through sensory and cognitive *discovery*. From discovery we move to *contact* as we seek to learn more about natural objects through touch. This is followed by *intervention* and *influence*. Intervention applies to those activities that interrupt natural processes and is closely associated with the ‘interference’ that intrinsic value theory cautions against. Influence, on the other hand, is a generative force, producing new change rather than just disrupting existing systems. Acampora offers by way of example a dam as an ‘intervention’ in the river flow, and a sewerage outlet as an ‘influence’ over the water composition. Then, “[o]nce the shapings and promptings of intervention and influence have effected phenomena of control or mastery, we have entered the grade of *domination*” (p. 222), which, at its extreme, grants humans deterministic power over an entity’s characteristics and conduct. Beyond this is the realm of human invention, *constitution* or *construction*, seen as human art, culture, tools and artefacts²¹⁰. Acampora asks, “[w]here along this spectrum of presencing—between the extremes of absolute distance (nature totally beyond culture) and pseudo-divine artistry (nature wholly produced by culture) might we best find cues for an engagement-without-

²¹⁰ Acampora rejects the possibility that biotechnological developments are undertaken at this level, though there is much literature that presents it otherwise (see Chapter Five).

exploitation model in our relationships with other forms of life?” (Acampora 2004: 222). *Discovery* and *contact* run the risk of reifying nonhuman others as mere objects, while *domination* and *construction* deny the alterity of the organism by ‘going too far’. Even if traditional domestication is understood benignly as *influence* under Acampora’s schema, this still leaves the question unanswered as to whether this kind of categorisation allows for a distinctly positive – rather than merely less negative – human role.

Moving to relationship: limits of the nature/artefact ontology

Hettinger’s (2002) previous recommendation that a much simpler distinction be made between the human *alteration* of nature and the human *domination* of nature²¹¹ lends itself to consideration of the quality rather than just the impact of the intervention. Domination is “a relationship between two parties where one party (the dominator) totally and successfully imposes its will on the second party (the dominated)” (Lee 1999: 118) that is recognised as morally undesirable on this basis (Brennan 2007). Alteration need not entail such totality. The most comprehensive environmental ethics explication of the impact of different interferences with nature is the artefact/natural object ontology (reviewed in Chapter Five), which can be appreciated as a continuum within which there exists degrees of alteration and artefactuality (Lee 1999, 2003a, 2003b). Although this continuum does offer some way to appreciate domestication as an incremental process, it is ultimately not nuanced enough to account for the potential values of domesticated nature, or the different intentions behind the interventions. Even a continuum upholds an appraisal of domestication as a source of disvalue: a natural object loses value and moral considerability once it starts down the road of becoming artefactual (Lo 1999). This makes it difficult to appreciate the natural value of contemporary domesticated nature as is recognised and defended in popular objections to further biotechnological intervention. A defining feature of artefactuality is the extent to which human intention is responsible for the creation of a particular form but, notwithstanding the further condition that the resulting form ought to have an instrumental use for humans (Katz 1993, 1997, 2002), this criterion is not concerned with the attitude of the intervention; it remains blind to the intent behind the intent. An intervention in the evolution of crops that sees a traditional farmer saving seed from a particularly crook-necked sorghum plant because it will be easier to hang from the rafters (Fowler & Mooney 1990) registers the same level of human intent as contemporary breeding for ease of mechanised harvesting (Baldanzi *et al.* 2003). A deliberately respectful domesticatory

²¹¹ This is similar to the distinction to be made between instrumentalist and anthropocentrist conceptions and valuations of nature (see Chapter Three), although Hettinger’s distinction is specific to the project of building an ethic for the use of nature, not just an ethic of its preservation.

intervention using organic plant breeding principles (Lammerts van Bueren *et al.* 2003; Lammerts van Bueren & Struik 2005) is similarly equivalent to the use of mutating chemicals and radiation to induce genetic variation. Artefactuality is primarily concerned with whether the intervention was intentional, but the distinction between alteration, domination, and Acampora's "engagement-without-exploitation" is largely a difference of attitude, though this is not made visible by Acampora's schema or within the definition of an artefact.

The question as to what might stand in as an alternative description or qualify as an addendum to the natural/artefactual distinction is answered here by a shift away from a concern with ontological and axiological status and toward the quality of human-nature relationships. The artefact/natural object dichotomy provides a relatively static ontological basis for the ascription of value even though domestication is not an unchanging state but a dynamic, long term and very intimate human/plant relationship. Writing in defence of restoration ecology, Light (nd) rejects the problem of determining the artefactual status of restored nature in favour of adopting a relational account of the value of restoration activities. Even if restored nature is classifiable as a culturally produced artefact, our relationship with that nature can still be morally important. Artefactual natural objects can still be "the unique bearers of meaning for relationships between humans that holds strong normative content, and in that sense we can interact with them in ways that can be described as better or worse in a moral sense" (p. 12). Thus, persistent uncertainty about whether domesticates qualify as artefacts does not preclude us from being engaged in environmentally and ethically meaningful relationships with them. Material interaction with nature *via* ecological restoration projects can foster an ecological consciousness and connection to place that, unlike the connection to a 'primordial' nature that is purported to result from experiences of wild places, "might do something much more important: help us to find a way to live as better environmental citizens" (p. 4). Physical engagement with less-than-wild nature in the reproduction of nature can be a 'restorative relationship'. Although ecological restoration projects are frequently open to public participation, contemporary domestication is not: plant breeding activities in industrialised agriculture have well and truly shifted from farmers to professionals. However, the positive value of more labour intensive modes of agricultural and domesticatory practice, and of maintaining the possibilities for such alternatives, is advocated. As the mediation of nature by bodily labours, it is a key element of ecofeminist critique of patriarchal capitalism and its dominant politico-economic structures (Mies & Shiva 1993; Salleh 1997; Mies & Bennholdt Thomsen 1999). As with Light's restorative ecology workers, agricultural and domesticatory practices at the subsistence level reproduce the conditions of life and foster a kind of ecological

sensibility that is inaccessible to those who do not do this work (Salleh 1997). Ecological restoration also produces other environmental positives, such as increased biodiversity and wildlife habitat, as can particular kinds of sustainable agriculture. Recognising the possibility for domesticatory relationships to qualify as restorative relationships is not agrarian idealism, but part of a comprehensive political critique by agricultural and ecofeminist activists, which has key areas of overlap with environmental virtue ethics accounts of human flourishing and agricultural aesthetics appreciations of bodily immersion in nature (see Chapter Four).

The restorative relationship is not dependent on the participation of wholly non-artefactual nature, as the relationship can be positive or negative in itself without recourse to identifying some harm to sentient or intrinsically valuable others (Light nd). Neither does a meaningful restorative relationship with nature require reciprocity from a sentient other; it can be formed with plant life – Warwick Fox’s (2006) iso-experients that are biophysically embodied but have no mind-like consciousness, or Martin Buber’s (1970) nature at the pre-threshold of mutuality. A relational environmental ethic is interested in the quality of the relationship, not the status of its participants. It ultimately takes an anthropological approach that is concerned with what kind of beings humans are and how this is enacted in their orientation to the natural world. Respect for the otherness of nature is key to this formulation. Thus, when Val Plumwood (2002: 405) recommended a move away from the preoccupation with determining the ontological and axiological status of various forms of nature and its eligibility for moral consideration, she argued that it is not the status of natural entities but rather our “willingness and ability to recognize the other that tells us whether we are open to potentially rich forms of interaction and relationship which have an ethical dimension. That is, it is not so much a question of whether THEY are good enough for ethically rich relationships, but of whether WE are!”. Similarly, in cautioning against the tendency to seek a ‘dangerous purity’ from nature through natural/artefactual distinctions, Stephens (2000: 278) underscores the importance of the motivation behind the relationship with nature:

instead of supposing that we must view man and nature dualistically, with only servitude or domination as our choice for modes of relationship, a third path of human action in the world opens up, in which we are bonded to nature through our interactions with it. Such an orientation resonates with the ethic of respectful use, but crucially, in the initial process of perceptual and practical encounter with natural items, it *begins* with engagement and openness to possibility rather than an immediately instrumental motivation or orientation.

The relational account affirms and progresses the general environmental ethics proscription of instrumentalism in our dealings with nature. It addresses the persistent problem of reconciling the intrinsic value of nature with its instrumental use and modification under domestication by shifting concern away from proving the existence of the intrinsic value of the other that precludes its instrumental use to whether the relationship is approached with openness, willingness and respect²¹². What matters in relational ethics is that we approach nature as though it were intrinsically valuable, and not exclusively as a means to our ends but as an end in itself. The wild otherness that persists in domesticated nature need not be stringently assessed for its possession of intrinsic value in order for humans to treat domesticated nature as more than a means to an end: “deepening our relationship with plants or animals renders certain questions about integrity or intrinsic value obsolete. Authentic experience shapes our moral attitudes” (Wirz 2001: 3). Relational approaches are more concerned with modes of perceiving, encountering and engaging with the other.

Moving to relationship: acknowledging the other

In describing domestication as a process of the human production or creation of biological artefacts, the artefactual/natural object ordering necessarily downplays the causal or affective role of nature. This is problematised by the recognition of the primacy of the botanical characteristics and biological processes of food plants to their domesticated form (Pollan 2001; Sperber 2007). Plumwood (2001: 24) criticises the narrow focus of this approach for its preclusion of an appreciation for the other:

²¹² This resolution might also be achieved in part by adopting a broader framework of intrinsic value theory, specifically, a conditional account of intrinsic value (Olson 2004; see also Rabinowicz & Ronnow-Rasmussen 1999). The traditional Moorean definition of intrinsic value relates to a quality that is intrinsic to the object that possesses it. The object possesses this value independent of the contexts or circumstances in which it exists: “if the intrinsic value of some F depends exclusively on the intrinsic nature of F, then F has the same intrinsic value in whatever context it appears (provided of course that the intrinsic nature of F is kept intact)” (Olson 2004: 32). The other definition of intrinsic value, and the one that is more commonly used in environmental ethics, is the value that something has for its own sake, or its *final value*. Under the first definition, the intrinsic value of F is also its final value. Nothing about the context of the object can affect its final value; if something is valuable as an end in itself it derives that value from an intrinsic property. However, under the second definition, there is more room for other values to contribute to final value: “the value that [F] has for its own sake, or as an end may well supervene on properties non-intrinsic to F” (Olson 2004: 32). Unlike instrumental value, which is always derived from some other value, final value supervenes on other values. Both derivation and supervenience are relations of dependence, but supervenience is not reducible to its composite values. Instead, it relates to the creation of an emergent value from the collection of other valuable properties, states or conditions. This final value is intrinsic in the sense of being valuable as an end in itself. In the case of domesticates, the other properties, states or conditions upon which final value supervenes might include the accompanying social and cultural nexus of seed saving and replanting, the deliciousness of the edible parts of the plant, or the extent of its retained wildness; in short, the quality of the relationship between plant, people and landscapes. Conditionalism is a version of intrinsic value that allows for domesticated nature to be finally valuable in particular contexts. Some version of conditionalism is at play in positive environmental ethics appraisals of sustainable agricultural systems. A possibility similar to conditionalism is suggested by Elliot (2005: 55) in his argument that the instrumental value of any entity is a consequence of that entity’s intrinsic value, thus instrumental value can be conceptualised as value-adding.

[s]tatic, one-sided narratives of humans [producing] nature do not envisage the possibility of mutual production, failing to allow for humans co-producing with an equally productive nature or to recognise that nature also produces us as well as we it.

The failure to acknowledge the participation of nature in domestication is a failure to recognise domestication *as* a relationship. The environmental ethics literature offers two different approaches to forming relationships with the other. They have been broadly summarised as focussing either on the difference or the similarity between other and self (Plumwood 2002; Castree 2003c). The deep ecology approach endorses a relationship of solidarity with nonhuman others, based on the fundamental interrelatedness of all life and the equal standing of humans and nature as biophysical, ecologically embedded organisms. It advances an anthropological account of encountering otherness in which it is the identification of the self with the other that is central to human self-realisation (Naess 1989; Fox 1991; Katz, Light & Rothenberg 2000). This expansion of the sense of self to include the well-being of nonhuman others allows ethical relationships with nature to emerge from simple self-interest. It is the recognition of sameness as across difference that informs a respectful mode of engagement with the other. The second approach to encountering the other instead emphasises the radical difference of the other, the autonomous trajectory of its history, and the unknowability of its experience. It also tends to posit this otherness as the source of the other's natural value (Hailwood 2000; Stephens 2000). Respect for the otherness of nature is shown in the mode of engaging with the unknowable element, in adopting strategies to preserve its autonomous space. It is in service to this model of natural otherness that Martin Buber's (1970) philosophy of dialogue has been turned to the task of providing a moral bearing for our relationship with nature (Evernden 1985; Lim 2001). Buber presents two options for encountering the other – either as a Thou (a fellow subject) or as an It (an object). The difference between an I-It and an I-Thou relationship is the difference between living in a world of objects and a world of subjects. Both deep ecological and Buberian relational accounts reject instrumental rationality in our dealings with nature for facilitating environmental harm and for having a diminishing effect on our selves, the richness of our experience of the world, and our capacity for self-realisation.

Val Plumwood's (2002: 200) critical review of these two modes of conceptualising our relationship with the other suggests an intermediate approach to take account of "the precarious balance of sameness and difference, of self and other involved in experiencing sameness without obliterating difference". She argues that nature is neither a pure other or pure self but a "conceptual, energetic and material dependence of self on other". In the case of domesticated nature, this mutual dependence is traced through the co-production of

domesticates that, in the absence of a definitive self/other ontological and axiological schism, can be viewed positively as a collaborative effort.

The most definitive advocate of non-interference by humans in nature (for whom even well-intentioned interference is devaluing) acknowledges, in recognition of sustainable agriculture models that imitate ecological systems, that “not all [human-nature] interactions are instances of unequal power relationships; to use a biological concept, some actions are symbioses” (Katz 1997: 114). This description of the human/plant relationship as symbiotic entails a revision of the domesticatory relationship as a partial and unfavourable partnership in consideration of the possibility that it may constitute a valuable assemblage in itself. This revision is a key theme in domestication studies scholarship (see Acampora 2004; Cassidy 2007). Animal studies scholar Vicki Hearne has said of the working canine-hominid partnership: “[it] is not an incomplete version of something else. It is a complete dog-human relationship” (in Acampora 2004: 223). Contemporary home gardening experiences – clearly distinct from but certainly more akin to the botanical encounters of early domestication than industrial agriculture – witness the gardener as “the contented ‘plantsperson’ working with a lively and dynamic set of non-human companions” (Hitchings 2003: 107), and gardening as “an embodied engagement between active human and non-human actors” (Power 2005: 39). If the use and domestication of nature is not conceived as synonymous with its degradation, then these “interspecific relationships can have their own authenticity” (Acampora 2004: 223). Once the morality of approaching these species is freed from the either/or choice between remote respect and limitless instrumentalism, the question of what factors, processes and characteristics make such interactions ‘authentic’ becomes the moral query.

If humans are granted a positive role in domestication, domesticated plant (and animal) forms could be describable as the results of a co-creative collaboration between humans and nature. The designed garden as a possible site for symbiosis is explored in garden literature and recently in Thomas Heyd’s (2006: 200) account of botanic gardens as “models for collaborative relations between human beings and the natural world”. The gardens are built to human design, but these crafted spaces are tailored to the needs of botanic species and grant them free expression to *be* plants. This kind of collaboration highlights “the possibility that we may be *partners* with plant life, not just its owners or protectors” (p. 205). Gardens represent spaces where humans can have a positive influence on plant life, and share with garden history literature the extension of Cicero’s (43 BCE [1972]) division of natural world into first nature (wild spontaneous nature) and second nature (the nature humans use and grow for food) to include the relationship of third nature (the aesthetic and detailed design of gardened nature) (Lawson 1950; Spirn 1997; Hunt 1999). The distinction between second

and third nature is the difference between a field and a garden, and “between the effects of merely utilitarian intervention in the landscape, and interventions in which there is an attempt to collaborate with nature” (Littlewood 2001: 22). The relevance of this distinction for domestication depends on whether the sentiment of third nature can be transposed into the realities of second nature.

Christoph Rehmann-Sutter (2001: 4) sees such a possibility for agricultural plant breeding as “an art which is led by the idea of partnership”, a form of creative relationship that is also articulated in organic plant breeding principles²¹³ (Van Beuren *et al.* 2003; Van Beuren & Struik 2005). Describing domestication in such terms is also possible within an evolutionary framework *via* the notion of human/plant coevolution. Through the domesticatory relationship, plants undergo evolutionary change (although the notion of ‘evolution under domestication’ is somewhat of a tautology: to domesticate plants [or animals] *is* to become the significant force in their evolution). The concept of *co*-evolution, however, also draws attention to the reciprocal, but by no means equivalent, impact that plants have had on humans. It situates domestication not as a process of human domination of nature, but as a long term, ecologically intimate relationship.

Domestication as a coevolutionary relationship

Coevolution is an aspect of evolutionary theory that describes the interdependent evolution of two groups of closely associated organisms (Ehrlich & Raven 1964; Jackson 1996; Vermeij 1994; Clark 2001). Whether these organisms are each other’s predator, prey, parasite or competitor, their activities are so ecologically entwined that they effectively constitute a large part of each other’s environment. Through time, the two sets of organisms exert a strong selective pressure on each other: the genetic changes undergone in one group shape the evolutionary change of the other, and vice versa. The tightly coupled evolution of flowering plants and insects that is responsible for the present diversity of flowering plants is a case in point (Kearns *et al.* 1998). Over evolutionary time, the feeding habits of visiting insects selected for defensive biochemical and mechanical properties in plants, which are in turn selected for particular insect morphologies, and so on in a negative feedback loop

²¹³ The organic plant breeding principles articulated by Van Beuren and Struik (2005) outline the obligation to respect the *integrity of life* (the plant as a self-regulating being, with its own telos; essentially a Taylorian biocentric obligation), *plant type integrity* (the specificity of the nature of plant organisms), *genotype integrity* (the qualities that are specific to the plant as species), and *phenotypic integrity* (the observable physical and chemical characteristics of the plant). The principles are pluralistic and diverse, and emphasise the importance of the plant in its environmental context. They are the basis for the rejection of the use of artificial chemicals, biotechnology, synthetic growing mediums, plant tissue culture in organic farming and plant breeding.

(Ehrlich & Raven 1964). Whilst coevolution proper refers to reciprocal genetic changes taking place in both sets of organisms, the human domestication of plants is regarded as coevolution or, more accurately, as an aggregate of particular occurrences of coevolution. Humans and domesticated plants are ecologically intimate. Through domestication, humans have effected a significant genetic change in plants, and, although the domestication of plants has effected more of a cultural than a genetic evolution in humans, there has in turn been some identifiable genetic change, albeit limited, in humans. The asymmetry of the extent of genetic changes undergone by each organism group is not inconsistent with the coevolutionary model, however. First, different kinds of organisms in a coevolutionary relationship do not typically have an equivalent evolutionary effect upon each other: annual plants will obviously evolve at a faster rate than their longer lived grazers (Vermeij 1994). Second, human cultural change is customarily counted as evolutionary change in accounts of domestication *qua* coevolution (Gatherer 2006: 58). While “[a]nimal and plant populations coevolve as selection occurs for those phenotypic variants that increase the fitness of both populations ... natural and cultural selection both are involved when the animal population is human” (O’Brien & Wilson 1988: 959).

The concept of coevolution is applied to domestication in the literature in different ways to emphasise a range of characteristics of the relationship. In some cases, domestication is described as coevolutionary simply to invoke the large timescales of evolution and highlight the long period that the domesticatory relationship has been in force. The coevolutionary aspect of domestication is also used to contextualise the commonly cited reliance of domesticated plants on humans for their survival by emphasising humans’ dependence on them for our survival (Busch 1991). It is, however, primarily used to draw attention to the highly localised nature of domestication. For most of its history, domestication has take place *via* a series of geographically dispersed, very particular people-plant relationships. It has its origins in perhaps nine different regions of the world²¹⁴ (Fowler & Mooney 1990; Gepts 2004; Verhouvern 2004). The oldest, the Fertile Crescent of Southwest Asia, was cultivating wheat, peas and olives in 8500 BC. China was farming rice and millet by no later than 7500BC, and in 2500BC Eastern North America was cultivating sunflower and goosefoot. By 3500BC the people of Mesoamerica had brought corn, beans and squash into the fields, and the Andes – and perhaps also Amazonia – had domesticated potatoes and manioc (cassava). The spread of agriculture – across the European continent from 7000 to

²¹⁴ It is unclear in the evidence as to whether the other four sites of domestication were truly independent in their origins, however, Sahel (by 5000BC), Tropical West Africa (by 3000BC), New Guinea (perhaps by 7000BC), and Ethiopia (at a date unknown) all brought local native foods under cultivation – respectively: sorghum and African rice, African yams and oil palm, sugar cane and banana, coffee and teff (Fowler & Mooney 1990). In the

3000 BC at an average speed of about 1km per year (Gepts 2004) before a “gradual, cross-cultural, worldwide transition to agriculture” (Jackson 1996: 164) – introduced these and other domesticable plants into new climatic and cultural environments. There were several waves of domestication – from basic food crops (primarily annual grains) to fruit and vegetable and, later, forage crops (Gepts 2004) – and the modern diversity of grains, grasses and legumes, tubers, berries, fruit trees, nut trees, herbs, root, leafy, stem, seed and flower vegetables, and beverage crops produced the particularised and contingent histories of the people-plant relations within which they were embedded.

The properties of domesticated animals and plants that made them more amenable to domestication – such as the genetic plasticity of the annual plants that became our major grain crops, and the sociality of herds that easily accepted leadership to become our domesticated livestock – exemplify the capacity of organisms to be responsive and form strong dependency relationships with other organisms. Intimate inter-species associations exist in nature that closely approximate, or are analogous to, the domesticatory relationship. A commonly cited example (see Rindos 1984; O’Connor 1997) is that of the mutualistic coevolutionary relationship between some ants and aphids, where ants source their honey dew from the aphids’ excretions and in turn protect them from predation (Stadler & Dixon 2005) in a relationship that is “strikingly similar to that between humans and domestic bovids” (O’Connor 1997: 152). Insect fungiculture practiced by termites, ants and ambrosia beetles displays nearly all the behaviours of human agriculture, and the choices made by attine ants in their cultivation of fungus are comparable to artificial selection under domestication (Mueller *et al.* 2005). These kinds of coevolutionary relationships are not restricted to the observations of entomologists. Flowering plants frequently recruit the work of mobile animals in their reproduction and as strong dependencies develop, these relationships become more than simple predation. A case in point is the African aardvark (Rindos 1984) that gets its precious water by eating the juicy melon *cucumis humifructus*, protecting the aardvark from predation at a water hole. When the aardvark ‘plants’ the melon’s seeds in small mounds by way of its cat-like faecal burying activities, it increases the likelihood of germination, which was already greatly improved by the seed’s journey through the digestive tract. Through the selection pressures exerted on both species, the melon has developed into a tastier, non-bitter variety, and the aardvark has become its primary dispersal agent.

main centres at least one source of carbohydrate (a cereal or root/tuber crop) and one source of protein (a legume crop) were domesticated (Gepts 2004).

In recognition of the similarities between domestication and other intimate ecological relationships that exist in wild nature, botanist-turned-anthropologist David Rindos (1984) describes agriculture as a high quality, coevolved dispersal scheme. Environmental archaeologist Terry O'Connor (1997: 152-153) points to the ecological aspects of domestication through which “mutualistic and commensal relationships developed between people and other species, either because the interaction was to the benefit of both species, or because it was beneficial to one and neutral (or at least not strongly detrimental) to the other”. Viewed as an ecological rather than purely cultural dynamic, domestication displays ‘natural’ qualities that could belong within an integral, stable and beautiful biotic Leopoldian community instead of outside it.

Agriculture: coevolutionary beginnings?

Perhaps the most enthusiastic application of the coevolutionary concept in domestication is its use as an explanatory model for the very origins of agriculture. Departing from the emphasis on social competition and cultural advancement that characterises cultural approaches to understanding agricultural origins and the population pressure, climatic change, and resource-depletion of strictly environmental approaches, the coevolutionary model casts agriculture in evolutionary rather than revolutionary terms and “views agriculture as the outgrowth of evolutionary potentials” (Rindos 1980: 751). The coevolutionary theory of David Rindos²¹⁵ (1980, 1984) emphasises the ecological role of humans in early domestication, where deliberate intent and invention was not necessary (although it is not denied either), and places the development of human agriculture on par with coevolutionary relationships between plants and animals in the wild. Pre- (and post-) agricultural people filled an ecological role in aiding the plant’s reproductive process by dispersing their seeds away from the parent plant – and so diminishing inter-generational competition for sunlight and nutrient – and providing seedlings with fertile ground that encouraged growth and fitness.

In the coevolutionary model of agricultural origins, domestication developed through a three-phased process. Significantly, two of these phases describe the development of attenuated forms of plant domestication before cultivation. Domestication is not only an ongoing effect of agriculture, but “*is the reason agricultural systems develop*” (Rindos 1980: 752, original emphasis). In the phase of incidental domestication, the foraging practices of hunter-gatherers exert a selection pressure on the wild plants they collect and

²¹⁵ The model of domestication as an ecological ‘accident’ is not confined to Rindos’ work; see Terrel *et al.* (2003) for an examination of this scholarship. On animal domestication in particular, see Jarman (1976); Budiansky (1999); O’Connor (1997).

protect. In this phase, people have a limited role in dispersing the plants' seeds and propagules, but their collection of preferred varieties does effect an increase in these varieties in the population. Soil and vegetation disturbance around dwelling sites also provide the ground for those proto-domesticates with weedy qualities to become established, though the extent of this phase is limited by the "relatively small size of human populations, broad-spectrum collecting activities of the humans, spotty distribution of plant species, and competition with non-human agents of dispersal" (O'Brien & Wilson 1988: 959). As a result, it is difficult to find supporting evidence for incidental domestication in the archaeological record. The next phase – specialised domestication – saw humans intensify their relationship with particular plants in response to the selective pressure of incidental domestication and adopt a more important role in their protection and dispersal. People changed their subsistence strategy to include weeding, watering, fire 'farming' and storing, plants increased their yields and displayed more of the domesticated phenotype, and the relationship began to move from one of opportunism to one of obligation. Agricultural domestication began when these plants began to be deliberately cultivated in specially prepared fields. People maintained their role as protectors and active agents of seed dispersal by selecting, collecting and planting seed, removing competing vegetation, aerating the soil, and supplying water to the specified site. Under the selection pressure of the agroecology, cultivated plants developed into an array of forms, plants that started out as weeds became important crops plants, and new domesticates were introduced into the field. Proto-domesticates developed non-shattering seed heads, uniform germination times, and some even changed their reproductive biology as a result of the selection pressure applied by human food needs and desires. In keeping with his contention that analogous domesticatory relationships also exist in wild nature, Rindos (1984: 256) thus defines agriculture as "an integrated set of animal behaviours that affect the environment inhabited by domesticated plants throughout the whole life cycle of those plants".

The coevolutionary model has been subjected to considerable critical review in the field of anthropology²¹⁶. It has also been commended for introducing a new paradigm to the study of

²¹⁶ Criticisms of the coevolutionary model for the origins of agriculture (see Blumler & Byrne 1991) challenge whether domestication could have preceded cultivation. Working with a definition of domestication as the inability to survive in the wild, Blumler & Byrne (1991:25) argue that domesticated phenotypes could not have gained a significant foothold in wild populations and "can be expected to be present in only very small numbers or perhaps to become locally abundant for a very short time under special conditions". While Rindos argues that agriculture would have been impossible without pre-agricultural domestication, these critics query the extent of supposedly wild characteristics in the wild such as seed dormancy. Similarly, they contend that primary domesticates did not possess the weedy characteristics required for their gradual colonisation of disturbed habitats under the model of incidental and specialised domestication, though the weediness of plants is not a static quality, and their status in this regard may have been different thousands of years ago (Bohrer 1991).

There is also significant disagreement about the estimated pace of domestication and the question of whether the evolutionary transition from wild to domesticated phenotype would necessarily take a long period of time. There

agricultural origins (O'Brien & Wilson 1988) and offers a broad evolutionary framework for a non-dualistic understanding of domestication. The most apparent implication of the coevolutionary model of agricultural origins for environmental ethics is that it affects the way that domestication can be reasonably represented in biotechnological discourses. The recurring soritical argument that conflates the practices and morality of genetic engineering with traditional domestication assumes, as its base, a strict differentiation between hunter-gatherer food provisioning and the beginnings of agriculture. If agricultural beginnings can be appreciated as more evolutionary than revolutionary, then the marketing of genetic engineering in agriculture as merely one more intervention in a string of 'unnatural' domesticatory practices becomes even more problematic. The revolutionary status of original domestication is upset, and the origin of the wild/domesticated split itself loses its precision.

Even in the absence of a coevolutionary model of origins, the idea that domestication can stand as the clear and constant reference point on the human subsistence landscape between hunter-gatherer and agriculturalist is problematic (Haber 2002; Terrel *et al.* 2003). Hunter-gatherers worked with an extensive amount of knowledge about diverse flora, growth cycles, and soil types: "knowing how to hunt and gather is not so different from knowing how to plant and cultivate" (Terrel *et al.* 2003: 333). The transition to agriculture is thought to have been preceded by a 'broad-spectrum' revolution by some 5000-10,000 years, in which people widened their subsistence base, switching from large game to smaller animals and plants and grain, and developing new tools and techniques (Flannery 1969). The extension of the Neolithic revolution across longer time periods, and the removal of intentionality as a prerequisite for domestication, allows for a less severe interpretation of agricultural origins, *contra* the positioning of agriculture as the original 'fall from grace' in some environmental ethics literature (Oelschlaeger 1991; Shepard 1996).

In a review of the various archaeological, biological, and geographical approaches to domestication and the origins of agriculture, Melinda Zeder (2006: 115) supports a balance between recognising causal influence in social and natural forces, concluding that

are many instances of rapid domestication, such as the single generation hybridisation of cultivated and wild grasses to produce emmer wheat, and very long domestication, such as spelt wheat (Blumler & Byrne 1991). If domestication can take place within a few generations, then it can feasibly occur within the agricultural field, though such pace in the case of cereals is heavily dependent on the choice of harvesting technique (Byrd 1991). The issue that attracts most attention is Rindos' contention that human intention, insofar as it is not verifiable, is not a relevant factor in his coevolutionary model (Blumler & Byrne 1991). Although these authors do recognise the role of unconscious behaviours in creating domesticated forms, they maintain that "it was finally man [*sic*] who chose to exploit the changing forms" (Ceci 1980: 766). It is important to note, however, that a lack of conclusive evidence is characteristic of the archaeobotanical, archaeological and anthropological data for this period across the geographic sites of domestication, even with technological advancements in collecting data (Smith, BD 2001).

domestication ought to be regarded as “a form of biological mutualism transformed by the highly developed human capacity to effect behavioural change”. However, there is a prevailing uncertainty about the detail of agricultural origins in the literature, which has shown the development of agriculture to be highly dependent on the variable factors of place, time and circumstances:

[n]o longer open to easy and universal explanation as a rapid and straightforward transition between adaptational steady states, the development of the shift from hunting and gathering to agriculture has in the past several decades blossomed out into a set of long-unfolding and fascinatingly complex, regional scale developmental puzzles (Smith, BD 2001: 1324).

Emphasising the ecological and evolutionary elements of these puzzles does not displace the key role that human intentionality has had in domesticatory history. Rather, it highlights the primacy of environmental factors and the ecological situatedness of shifting subsistence choices (Winterhalden & Goland 1997). A similar effect is achieved through the emerging recognition of ‘niche construction’ in evolutionary theory (Day *et al.* 2003; Odling-Smee *et al.* 2003). Niche construction relates to “the capacity of organisms to construct, modify, and select important components of their local environments” (Day *et al.* 2003: 80). This typically denotes the creation of built environments like nests, burrows and webs, pupil cases, as well as the secretion of chemicals into the soil and air. The modified environment is involved in evolutionary processes both as the environment within which natural selection takes place and as a kind of non-genetic inheritance for the organism. Thus it is possible to consider contemporary humans as “advanced niche constructors” (Day *et al.* 2003: 92), who compensate for their poor adaptation to the wider environment through the creation of, and adaptation to, the built, inherited environment. Even hunter gatherers did not merely adapt to but niche-constructed their environment through their use patterns, exerting selection pressures on plant populations without actually domesticating their food source: “a landscape can be a *domus* filled only with wild crops” (Terrel *et al.* 2003: 349). In coevolutionary terms, the transition is not even described as the abandonment of hunter-gathering in favour of agriculture, but as a shift from an environmentally exploitative relationship to a mutualistic coevolutionary one. Appreciating the role of humans as ecological as well as cultural actors in the adoption of new subsistence strategies through evolutionary and coevolutionary frameworks allows for a more measured account of its effects.

Mutualistic coevolution: the other comes into view

The coevolution of organisms takes place when both sets of organisms are in competition for the same food source, or when one is exploitative of the other – through parasiticism, infection, grazing, or predation – or when both gain benefits by forming an intense ecological relationship. When both gain benefits, for the most part measured by their becoming prolific in the environment, this is known as mutualistic coevolution (O'Connor 1997; Kearns *et al.* 1998; Clark 2001). There are many instances of mutualistic coevolutionary relationships in wild nature. For example, the ant-acacias of Central America are home to colonies of ants that not only feed benignly on the plant itself, but also on surrounding vegetation—effectively weeding out competition—and on the small predatorial insects that would otherwise overrun and destroy the plant (Rindos 1984). With its defences maintained by the feeding and social behaviours of the ants, the acacia has freed up more energy for growth by ceasing production of defensive alkaloids that would have made it less tasty to predators. Because of the protection the ants give to the acacia, including protection from fire by clearing nearby growth, it has been able to colonise new geographies where other acacias are not able to survive.

Domestication falls under the category of mutualistic coevolution as, although one party depends on the other for food, the numbers of both have increased significantly as a result (Rindos 1980, 1984; Harris 1996; Jackson 1996). Entering into a domesticatory relationship increased the ecological fitness of both people and plants and allowed them to expand their numbers and the range of environments they could inhabit (Harris 1996; Diamond 1998). In addition to the increased population that genetic plasticity in response to human selection pressures has facilitated, plants' participation in the domesticatory relationship provides them with nourishment and protection from attackers, resulting in their production of sweeter edible parts as they lose their need to provide chemical defences (see Massey & Hartley 2000). The increased yield of crop plants is, in part, a metabolic by-product of those plants diverting energy to growth that they would otherwise have needed for their own chemical defences against pests (Rosenthal & Rodolfo 1997). Superficially, though, domesticated plants appear to bear all the costs of their association with humans and none of the benefits. They are often referred to, in one form or other, as “a class of organisms that benefit humans” (Arnold 2004: 998). The corresponding claim is not made for us. Yet one of the most obvious, and significant, ways that the tightly linked evolution of people and plants has affected each group of organisms is through their modern dependence on one another for survival. Those domesticated plant characteristics with a clear ecological function – namely, the lack of seed dormancy, the inability to auto-disperse seeds – make the plant more reliant on human beings for their survival than they were previously. This

dependence was commented on by Carl Linnaeus (1737), who observed: “[i]f these (cultivated) forms are no longer tended, if the gardeners do not bring daily sacrifices to their idols, then these playful shadows fall into a void” (in Evans 1993: 317). The human reliance on domesticated plants is acknowledged in extensive and expensive seed saving efforts to protect against the failure of future food crops, but this has not had a great impact upon the popular imagination. Even less attention has been given to the ways that human behaviours have been fundamentally changed by the effects of plant and animal domestication.

Human domestication

The original early seventeenth century usage of the term ‘domesticate’ related only to humans in the sense of their becoming part of a household (or *domus*), that is, becoming civilised (Anderson 1997). It is now more commonly used to refer to the modification of plants and animals²¹⁷ through their being brought into the *domus* by way of the agricultural environment. This definition is rarely reapplied to humans, who have nevertheless also undergone significant changes as a result of agriculture. Aversion to the notion of ‘human domestication’ in this sense is most likely an effect of the traditional understanding of domestication as the human domination of nature: “[i]f the definition of domestication requires that humans ‘drive’ the process as ‘masters’ and ‘creators’ of domestic breeds for human advantage, then the only domestication event involving humans as objects by this definition is slavery” (Leach 2003: 359) or, by the criterion of intentional selection, eugenics breeding programs (Leach 2003). It remains, however, that domestication is neither a unidirectional nor a necessarily conscious process and, although the notion of human domestication akin to animal or plant domestication is not conventional, it has been proposed (notably by Leach 2003). In the interests of parity, and given the extent of changes experienced by humans because of domestication, this section will examine different kinds of human domestication as components of the reciprocal domesticatory relationship. Adopting the term ‘domestication’ to trace the effect of domesticatory practices on humans has a primarily heuristic role, as “[w]e need a new paradigm which encompasses all aspects of the coevolution of plants and animals of the human *domus*, including us” (Leach 2003: 361), but while “some would save ‘domestication’ just for the process and consequences of selective breeding ... as long as it covers the results of unconscious selection as well, humans cannot logically be excluded” (Leach 2003: 364).

The domestication of humans is primarily recognised as taking place in a social and symbolic sense. The beginning of agriculture is historically associated with the beginning of

²¹⁷ By the end of the eighteenth century the meaning of the term was extended to include farm animals. It was still uncommon until the mid-twentieth century to use it to describe cultivated plants (Leach 2003).

human civilisation²¹⁸; as hunter-gatherer food procurement gave way to food production, and early agriculture expanded to incorporate selective breeding, humans were able to organise themselves into more sedentary, concentrated and intricate social and political relationships. The cultivation and husbandry of plants and animals, associated with, though preceded slightly by, community sedentism, and concomitant with greater social complexity and the development of other technologies, is traditionally associated with material progress (Anderson 1997). Humans are domesticated through this process in the original sense of becoming civilised. Early and classical domestication ‘civilised’ nature by making it more suitable for human needs and, as an art, an application of reason, and a demonstration of mastery, domestication in turn civilised humans. Geographer Kay Anderson (1997) has traced the idea that domesticated nature is itself constitutive of the normative idea of ‘humanness’. In Classical scholarship, the selective breeding of cultivated nature was taken as indicative of the unique character and position of humanity. This uniqueness was fortified by a favourable comparison of the cognitive and behavioural capacities of humans with those of domesticated animals, a comparison made possible by their close proximity. The ability to ‘refine’ nature and use it to the satisfaction of human needs brought with it a ‘sense of triumph’ (Anderson 1997: 471). In this respect, domestication was instrumental in the construction of an exclusively human domain as ‘culture’, as “domestication [came] to be narrated as the process out of which culture was constituted”. Here, domestication *qua* agricultural settlement is implicated in the conceptual division of the world into the two distinct orders of a human-inhabited ‘culture’, and a ‘nature’ that contained everything else (Mathews 1994; Anderson 1997; Russell 2002). In practical terms, “the dichotomous division between man and external nature increasingly became real in that it acquired an experiential base, for the physical separation of town from areas of nature functioned to reinforce the segregation of humanity from nature” (Stephens 2000: 277). It is the conceptual shift, and the necessary deforestation of the landscape that accompanied agriculture, that has been posited by some as the beginnings of the antagonistic environmental relationship between humans and nature (see Shepard 1973; Oelschlaeger 1991; Shepard 1998).

However, the domestication of humans has also occurred in the physical sense, and the long term intimate relationship between humans and plants has effects at the macro- and micro-evolutionary scale. *Homo sapiens* are biocultural organisms, whose physiology and cultural practices, in particular their diet, are interwoven and reciprocally influenced (Jackson 1996).

²¹⁸ This traditional view has been somewhat revised, and with the acceptance that hunter-gathering societies supported rich and innovative cultures, and that sedentism preceded agriculture (see Zeder 2006), the idea of the ‘birth of human civilisation’ is not so strongly married to the advent of agriculture.

For instance, humans' inability to biosynthesise Vitamin C is traceable to the fruit-consumption tendencies of early primates, which gave them a regular intake of plant-derived Vitamin C and precluded the need for its production in the body. Similarly, the much narrower diet of agricultural people repeatedly exposes them to particular plant-based compounds that alter their metabolic processes and can affect their genome, gene function and the expression of their phenotype. The biophysical effects of plant domestication depend on how widespread the consumption of particular plants are within a cultural group, but domestication broadly provided "an excellent ecological context within which highly intense, locally restricted human-plant specialisations could emerge" (Jackson 1996: 164). In locations where bitter (more toxic) varieties of cassava were preferred over sweet, they were detoxified through an adjusted internal metabolism as well as external practices of pulping and leaching. Naturally, people have intentionally concentrated their exposure to plant compounds that improve well-being. While the rise of domestication and sedentism did lead to the loss of accumulated information about the bioactive properties of wild plants, it produced a repertoire of knowledge about cultivated ones. Biological fitness has been improved for people who routinely drink tea (*Camellia sinensis*) containing polyphenols, and near-medical foods such as the hormone-like effect of liquorice in the treatment of ulcers. Northern Europe was traditionally too cold for wheat production, so modern descendents of its inhabitants have the highest prevalence of celiac disease. Probably the most commonly acknowledged genetic effect of domestication on humans is lactose tolerance in cultures that practised milking of domesticated animals, and lactose intolerance in cultures that have not practised dairy farming (Cavalli-Sforza & Feldman 1983; Rindos 1984).

Leach (2003, 2007) presents further evidence for biological human domestication that is not exclusively related to the domestication of plants, but rather to the artificial protective environments that were created by humans and shared by them with plants and animals where "the combination of adoption of a built environment, change in diet consistency, and lowered mobility brought about morphological changes similar to those seen in certain domestic animals" (2003: 360). Concomitant with the time frames of domestication, humans have undergone a reduction in body size, a reduction in skull thickness, and developed a shortening of the facial part of the skull and smaller teeth²¹⁹. Leach (2003: 359) offers an

²¹⁹ The causality of these changes in humans does differ from that of the same changes in domestic pigs, sheep, goats, dogs and cows. Smaller animal size would have been deliberately selected for ease of handling, a reduction in cranial thickness is likely an effect of removing natural selection for the big horns and thick skulls necessary for alpha male conflict by segregating males. The effect of micro-climate and reduced physical demands of sedentism are shared causal factors, though animal cranio-facial changes stem from the onset of neoteny (the retention of juvenile characteristics in adult life), and human cranio-facial changes come from their

expanded definition of domestication to refer specifically to “biological changes brought about through living in [a] culturally modified, artificial environment”. Through sharing the shelter and protection of their built environment with other animals, “humans precipitated bodily transformations shared with these other species, changes that could not have been intended or anticipated” (Clark 2007: 60). Both humans and domesticates have been transformed, albeit asymmetrically, by their participation in the domesticatory relationship.

Acknowledging plant alterity

The idea of human domestication provides some consideration of the affect that plants themselves have had on people. As an exercise in acknowledging alterity, this section looks at how the particularities of plant forms and tendencies have also affected the nature and design of the domesticatory practices in which they participated. This approach seeks to make visible, as far as possible, the otherness of the other, in some cases presenting a view of these activities from the standpoint of the plants themselves. Although it is not possible for people to escape their own “human epistemic locatedness” (Plumwood 2002: 132) and acquire real knowledge of the others’ experience – the otherness of nature is something that can be “encountered or expected, but never known” (Rehmann-Sutter 2001: 5) – tracing the affect of the other can introduce an appreciation for it. In this task, the use of evolutionary and ecological language such as ‘adaptation’ and ‘adopting a reproduction strategy’ allows for the treatment of both participants of the coevolutionary domesticatory relationship with a measure of equivalency, but does not suggest that plants can be attributed intentionality in any way that is comparable to humans. Instead, it effectively brings together evolutionary descriptions of ecological activity with some of the established environmental ethics descriptions of valuable natural entities. Domesticated plants are centres-of-a-life with their own teleology. They strive to grow, thrive and reproduce, and they have their own ‘good’ with respect to what kind of needs they have²²⁰ (Taylor 1986). Plants have their own way of being, their own histories, their own ‘autonomous space of meaning’ that is “beyond our human history, beyond our systems of meaning” (Rehmann-Sutter 2001: 8). We can therefore speak of domesticated plants having a ‘perspective’ without suggesting a reconfiguration of the actual qualities and capacities of plant life. The move is rhetorical, and specifically directed to uncovering alterity: “to actually encounter other beings *as* other, as living subjects of significance, requires some loosening of the conceptual bindings of

softer agricultural diet – that was made even softer for people, and perhaps some of their domesticated companions, by cooking (Leach 2003, 2007).

²²⁰ This basic biocentric position has since been progressed by more carefully constructed approaches, including Plumwood’s (2002) recognition of agency and mind-like qualities in non-sentient natural entities.

nature so that subjectivity can flow back in, like water to a scorched garden” (Evernden 1992: 108).

Foregrounding the role of nature in what are traditionally narrated as culturally-driven developments is also the approach taken by the field of environmental history. This field of study is concerned with making nature and landscapes visible as contributory elements of world history, in contrast to the standard emphasis on human agency, personalities and events (Foltz 2003). Unsurprisingly, this has generated scholarship on the role of domesticated and other plants in human history, particularly on the significance of colonial and pre-colonial plant transfers (see Crosby 1986; Worster 1990; Diamond 1998; Hoffman 2001; Diamond 2002; Beinhart & Middleton 2004). The search for exotic plant material that had motivated world voyages since Sumerian collectors travelled to Asia Minor around 2500BC in search of vines, figs and roses was also central to the fifteenth and sixteenth century European explorations and colonisations (Fowler 1994; Busch 1995b). Encounters between old and new worlds entailed encounters of previously unknown domesticated plants, and the resulting mass transfer of these plants between their respective continents – the ‘Columbian exchange’ – had dramatic social and political impacts. The influx of maize and potatoes from the Americas became staple crops in Europe, leading to large population increases. The replacement of indigenous flora with new and European crops in temperate colonies, and the establishment of plantation crops from plants transferred from Ethiopia to Latin America (coffee), China to India and Ceylon (tea) (Busch 1991; Fowler 1994; Beinhart & Middleton 2004) in tropical colonies, had a production advantage in the absence of coevolved pests and diseases and were key to the success of the European colonial empires (Crosby 1986; Fowler 1994). A global system of botanic gardens, established to collect, study, breed and commercially distribute food plants, was vital to colonial expansion and these became major and powerful institutions²²¹ (Fowler 1994) while the development in 1829 of the Wardian case, an individual transportable terrarium, increased the rate and range of transfers to an unprecedented level (Fowler 1994; Beinart & Middleton 2004). As valuable commodities, particular plants required defences against thievery. Keeping delicate citrus fruits²²² was a status symbol for the wealthy who kept them in secure orangeries (glasshouses), while the clandestine removal of rubber trees to establish plantations in Asia decimated the Brazilian rubber industry (Fowler 1994; Janick 2005).

²²¹ The Kew garden in London was the premier institution but, by the end of the eighteenth century there were approximately 1600 botanic gardens in Europe alone (Fowler 1994).

²²² Citrus fruits were domesticated in South East Asia. The sweet and sour orange was introduced into Europe in the eleventh century through Arab merchants, then lemon and pumello in the twelfth century, lime in the thirteenth, and a series of introductions of hardier stock in the fifteenth and sixteenth centuries (Janick 2003).

These exchanges were not determined by singularly human decisions but entailed a multifaceted combination of the priorities of institutions, colonising forces, politico-economic factors, climate, and the properties of the plants themselves²²³ (Beinhart & Middleton 2004). Even the role played by botanic gardens was not absolute – many important transfers took place outside of institutional contexts, where “[c]olonisation by gardening’ was a ubiquitous, everyday settler activity” (Beinhart & Middleton 2004: 14). However, the effectiveness of transfers relied as much on the botanical characteristics of the species in question, and the suitability of the climatic conditions of the new environment, as it did on people’s acceptance of the new plants (though this in turn was partially reliant on plant characteristics, such as flavour and addictiveness in the cases of sugar and cocoa) (Beinhart & Middleton 2004).

There is “a life intrinsic in every crop, in its evolution, its history, and its production” (Smith 1995: vi). Recognition of the effect that specific plants have had on cultures and economies is reflected in the contemporary proliferation of ‘biographies’ of food plants²²⁴ that trace the configurations of human social and cultural activities around the particularities of a plant and the food it provides. Progression of this particular area of study is also seen in the recent incorporation of domestication, and other anthropogenic evolution, into environmental history analyses (Russell 2003). The emergence of a new sub-field of ‘evolutionary history’²²⁵ not only foregrounds the role of nature in social developments, but adopts insights from the evolutionary sciences to see “humans, and a variety of social variables, as evolutionary forces, organisms as plastic and adaptive rather than static or passive” (Russell 2003: 213) and the changes under domestication as mutually affective.

It has even been convincingly argued that, because of the direct benefits that some domesticates (namely, domestic dogs) gain from their association with humans, they ‘chose’ domestication (Budiansky 1999). The coevolutionary model for agricultural origins, in essence, proposes the same thing, to the extent that entering into a domesticatory

²²³ Early work in environmental history (Crosby 1986) showed that the Columbian exchange was not entirely reciprocal but ecologically asymmetrical, despite the similarity of climates. New Worlds proved more ‘botanically porous’ to the old world domesticates that self-spread and naturalised as weeds in the new countries, because of the genetic responsiveness afforded by their rapid reproduction strategy. The extent of asymmetry and the usefulness of the ‘ecological imperialism’ thesis has recently been challenged by a closer examination of how the transfers are measured, over what time period, and from whose perspective (Beinhart & Middleton 2004).

²²⁴ For example: Hobhouse (1999) *Seeds of change: six plants that transformed mankind*; Pendergrast (1999), *Uncommon grounds: the history of coffee and how it transformed our world*; Fussell (2004), *The story of corn*; Rain (2004), *Vanilla: the cultural history of the world’s favourite flavour and fragrance*; Moxham (2004), *Tea: Addiction, exploitation and empire*; Pollan (2001), *The botany of desire: a plant’s-eye view of the world*; Rosenblum (2000), *Olives: the life and lore of a noble fruit*; Rosenblum (2005), *Chocolate: a bittersweet saga of dark and light*.

²²⁵ The prime example of such scholarship is the popular presentation of the role that the dynamics of early domestication played in the course of civilisation in Jared Diamond’s *Guns, Germs and Steel* (1998).

relationship with humans represented a highly effective reproductive strategy for food plants. In the ‘plant’s eye view of the world’ offered by Michael Pollan (2001: 20-21), humans did not merely domesticate the passive plant. Rather, crops ‘recruited’ humans to protect them from predation, to supply them with nutrients, and to assist them to become prolific, globally disseminated species:

By encasing their seeds in sugary and nutritious flesh, fruiting plants such as the apple hit on an ingenious way of exploiting the mammalian sweet tooth: in exchange for fructose, the animals provide the seeds with transportation, allowing the plant to expand its range. As parties to this grand coevolutionary bargain, animals with the strongest predilection for sweetness, and plants offering the biggest, sweetest fruits prospered together and multiplied, evolving into the species we see, and are, today.

From our standpoint, plants are working for us by providing us with vegetables, fruit and grain; from a bee’s standpoint, plants are working for them by supplying them with nectar and pollen. From the plant’s standpoint, both people and bees are working for them – pollinating, sheltering, watering and feeding, and doing the same for their progeny. The transfer of plants through colonial expansion involved the rapid proliferating of plant own populations – for example, the high yielding, easily processed and qualities of corn effectively ‘recruited’ people to spread the plant to most of Eastern hemisphere within 100 years from its European discovery in the Americas²²⁶. The genetic plasticity of food plants under domestication represents their responsiveness to their environment in ‘recognition’ of the benefits of their association with humans. Dan Sperber’s (2007) defence of the seedless grape as a natural object and not a pure artefact rests on a similar logic – seedlessness need not be framed as a triumph of culture over nature, but can be understood as the grape’s adoption of a successful reproductive strategy within its environmental context. Pollan’s rhetorical question of ‘who domesticated who?’ is not an assertion that plants had foresight, cunning or ambition beyond their proclivity to reproduce, beyond the seeming teleology that is granted to any organism by the benefit of evolutionary hindsight²²⁷.

The affect of plants on human activity can be described as a form of agency, but one that is not voluntary or purposive, that “does not have to be conceived on the model of consciously

²²⁶ To Italy and France by 1494, to Egypt by 1517, to Spain and Portugal by 1525, to Europe by 1571, the Balkan Peninsula by 1575, and Africa, India, and the Far East before the end of the sixteenth century (Smith 1995). The first mention of corn (maize) in China was in 1555 (Fowler 1994). In the 1980s corn harvests exceeded 440 million tons (Warman 2003).

²²⁷ The idea that plants ‘want’ their genes to become much more common in the population is the basic teleology read into the proliferation of any species through the use of evolutionary language. This assumes a model of the natural world in which ‘genes’ are imagined as the beneficiaries, if not the ultimate actors, of reproduction (Dawkins 1976; Sidler 2006).

self-produced freedom of individual will” (Acampora 2001: 76). Russell Hitchings (2003), in a study of the interactions between gardeners and their plants, provides a similar account of the gardening place and process from the ‘perspective’ of the plants. Hitchings speaks of plants as drawing the gardeners in to aid them in their survival in the garden by being ‘stoical’, or ‘lively and opportunistic’, noting that “different sorts of plants had different ideas about how to [survive] and manage the things around them to achieve those ends” (p. 105). This description is borne out of the observations of the point of contact between the specific nature of people and plants, and how people undertook and narrated their gardening tasks as a response to the growth habits, food needs and seeming obstinacies of the others that constituted the garden. These kinds of descriptions allow an appreciation of the plant as an other who ‘allows’, or does not ‘allow’, *via* their obdurate botanical and biological characteristics, particular modifications to take place (Rehmann-Sutter 2001). Through their biological and ecological barriers to reproduction and hybridisation, plants filter out possible future genetic configurations²²⁸. Their botanical characteristics have inherent opportunities and constraints. Thus, the to and fro between the domesticatory breeder and plant – as between the gardener and her garden – is not a one-sided domination but a bi-directional exchange that takes on the attributes of a conversation. Christoph Rehmann-Sutter (2001: 4) affirms this reciprocity in maintaining that plant breeding efforts “cannot change a plant. It is the plant that allows the changes”. The change from, say, the small teosinte seed head to the large succulent maize cob, is not read as a cultural triumph so much as a “tremendous latitude of allowance”.

In evolutionary parlance, people have benefited from domestication because plants responded to the selection pressure of humans by increasing the yield of their edible parts and making these parts sweeter, more colourful, more diverse, and more suited to human purpose. The benefits for humans are so prodigious that the plasticity and responsiveness of domesticates has even been framed as a kind of ‘generosity’²²⁹ (Clark 2007). A problematic attribute to ascribe to nonhumans that do not possess either intentionality or goodwill, ‘generosity’ is more truthfully a retrospective description of the effect of organisms’

²²⁸ Plants may have barriers that prevent self-pollination, such as bear male and female flowers on different plants, have an uneven maturation of pistils (female) and stamens (males) on the same plant, or produce a flower form that requires insect or bird activity for pollination (Janick 2005). Inter-species reproductive barriers include external factors, such as geographic and ecological isolation, temporal isolation where plants flower at different times of the day or year, and ethological isolation where plants have different insect pollinators. When species do cross-fertilise, the plant may abort the resulting seed, or it may be sterile or have poor ecological fitness so that it does not survive to reproduce (Van Raamsdonk 1993).

²²⁹ The notion of the generosity of domesticates is presented by Clark (2007) in an argument for the ‘corporeal generosity’ between humans and domesticated animals. Clark associates generosity with Derrida’s idea of the ‘gift’ that “overrun[s] the border, to be sure, toward the measureless and excessive” (Derrida 1992 in Clark 2007: 52). Excessiveness is also a feature identified by Elisabeth Grosz (1999) as an ethically significant aspect of natural and artificial evolution along with indeterminacy (as detailed in Chapter Six).

participation in domestication: an advantageous ‘non-volitional flow’ (p. 58) of goods between species. By facilitating an excessiveness of production – both in terms of yield and quality – domestication entails ‘mutually transformative relations between species’ (p. 52).

The idea of an embodied generosity hinging on the susceptibility of living beings to the ‘affect’ of other bodies helps turn our attention to the open-endedness of interspecies relations. It reminds us that the adaptability and creativity of living things is not simply an attribute of life in the ‘wild’, and neither is it a capacity that has been entirely appropriated and overwritten by human technological practices. Rather, it is an ongoing process found wherever species come into sustained and intimate relationships, whether these are intentional or incidental (Clark 2007: 66).

By this account – from their wild harvest to their amenability to domestication, to their significant responsiveness to human selection and the agricultural environment – domesticated plants have displayed a distinct generosity in their dealings with humans. They have redirected their photo-assimilated energy from biochemical protection to increase the yield of their edible parts, and have continued to increase these yields over domesticatory history²³⁰. They have increased the flavour and range of their edible parts – in brassicas, photosynthetic partitioning has resulted in a diversification from the singular wild progenitor to kale, cabbage, cauliflower, brussels sprouts, and, more recently, broccoli. They have even adapted their process of reproduction in ways that are more beneficial for agriculture. Plants of foods such as plums, peaches, apples, apricots, oranges, pineapples, and tomatoes and peppers, have changed from reproducing through inter-breeding – where characteristics are not preserved across generations – to reproducing through self-fertilisation and other non-pollinating methods that reliably pass on useful mutations to the offspring (Diamond 1998; Janick 2004). The small founder populations of domesticates, the pressures of new local environments, and the unconscious and deliberate efforts of plant breeders²³¹ has encouraged self-fertilization or ‘selfing’ (Simmonds 1979). Even though outbreeding is the basic state of angiosperms from which inbreeding evolved, now only a small proportion of domesticates outbreed. In bananas, plantains, cassavas and some grapes, sexual reproduction has been replaced by vegetative reproduction and the fruit has become seedless. Plants that now have a reproduction strategy that does not require pollinators have favoured local adaptation, at the expense of long term flexibility to change (Gepts 2004).

²³⁰ In the last 10,000 years, wheat yields have increased from 1.5 tons/ha to around four tons/ha in the U.S. and six tonnes/ha in China today. Rice has increased from 0.02 to one ton/ha; and in the last 2000 years corn has increased from 0.4 tons/ha to between four and six tons/ha. Yield rate increases are attributable to agronomic as well as genetic factors. It is positively correlated with increased biomass for higher rates of photosynthesis, increased seed size and increased inflorescence size (the stem that bears the flowers) (Gepts 2004).

²³¹ Generally, the earliest domesticates have been grains which, except for maize, are selfing and so breed true to type (Gepts 2004).

Nevertheless, humans have had to devise and practice very specific domesticatory activities to match the conformational and biological propensities of the plant. The reciprocal structure of the domesticatory relationship requires humans to adapt to the very particular ways that these plants exist in the world, just as plants adapt to their human selectors. For example, the practice of grafting²³² developed to retain desired varieties of fruit trees because most are highly cross-pollinated and highly heterogenous, producing an unfailingly unsuitable variety of progeny. It is also inappropriate to try to produce fruit from seed because of the long juvenile period of trees before they set fruit. Therefore, the cultivation of most fruits is based on the “vegetative propagation of unique phenotypes (elite clones) with subsequent improvement based on sexual recombination of elites” (Janick 2005). The serendipitous nature of discovering desirable clones in highly heterogenous fruiting species means that, once discovered, intensive efforts are made to prop them up by cultural practices: “artificial pollination, the use of disease resistant and size controlling rootstocks, extensive methods of disease control, including complex schedules of pesticide application, the control of fruit size and annual bearing by manual and chemical fruit and flower thinning, the control of fruit abscission with growth regulators, and extensive pruning and training systems” (Janick 2005). Interactions with plants have differed according to the organs of the plant that are eaten by humans – plants with edible vegetative structures needed protection before they would lose their chemical defences, while strongly outcrossing plants required spatial isolation (Rindos 1980), and some dioecious fruit species required artificial pollination (Janick 2005). Pre 3000BC Egyptian ‘scrapers’ wounded the flesh of every Sycamore fig to ripen it through the release of ethylene because the prized fruit would not mature without pollination by a particular wasp that fit into its hollow receptacle but did not accompany it on its journey from eastern Central Africa (Janick 2005). In the 1930s corn ‘detasslers’ undertook the labour intensive work of manually removing select male tassels to force cross pollination in large-scale corn hybridisation efforts (Fowler 1994; Smith 1995; Warman 2003). Such practices are shaped by the specificity of botany and biology.

The collaborative relationship

Looking to the benefits gained by domesticates entering a dependent relationship with humans, finding precedent in natural ecosystemic partnerships, and making the ecological basis of this development more visible, recasts the biological organisms in question as active participants rather than merely recipients of domestication. These perspectives offer the kind of “reconception of nature in agentic terms as a co-actor and co-participant in the world”

²³² Developed circa 3000BCE (Janick 2005).

that is commended by Plumwood (2001: 16) as “perhaps the most important aspect of moving to an alternative ethical framework”. It also represents a move away from the Lockean formula that only human labours give raw nature its value, that underlies the granting of intellectual property rights over conventional and biotechnological domesticates as human inventions. The domesticated entity is not a simple cultural artefact but is instead a hybrid of intentionalities, co-produced by human and plant desires. Through coevolutionary exchanges, “human ideas find their way into natural facts: the contours of a tulip’s petals, say, or the tang of a Jonagold apple” (Pollan 2001: xvi). The ‘aesthetic, material and experimental investments’ of artificial selection (Grosz 1999: 36) are mediated by, and made manifest, as botanical form.

The domesticate can be conceptualised as a veritable assemblage of human and plant in a similar way to what is often held up as the exemplar pair of coevolution – the mimetic orchid and its pollinating wasp (Deleuze & Guattari 1980: 10). The orchid has evolved the visual form and pheromonal scent of the female wasp, and lures the male wasp to pollinate it through pseudocopulation (Jersáková *et al.* 2006). The bond between orchid and wasp is such that their tightly coupled relationship across the kingdoms generates a new taxonomy – “a becoming-wasp of the orchid and a becoming-orchid of the wasp” (Deleuze & Guattari 1980: 10). The transferability of this description to the domesticate and its pollinating human is not immediate, because Deleuze and Guattari’s example favours the visual form of coevolving organisms over the function they perform for each other. Although the orchid that achieves pollination through sexual deception is often held up as the paradigm example of coevolution, this is not a mutualistic coevolution. Pollination is ecologically non-rewarding for the wasp. The orchid deceives; it does not provide the wasp with nectar (Jersáková *et al.* 2006). However, the elegance of the idea of ‘becoming’ each other through coevolution is not diminished because it has been anchored in this particular instance of sexual mimicry. ‘Becoming’ can be read into any coevolved pairing²³³, and is even more pointed in the case of mutualistic arrangements such as domestication where we can see the ‘becoming-plant’ of the Egyptian fig scrapers and the ‘becoming-human’ in the luring flavour of Pollan’s apple.

This conceptualisation of the domesticate has commonalities with perspectives from science and technology studies that offer a radical reconfiguration of ontology and reject the nature/culture dualism entirely. Drawing on the theoretical resources of Bruno Latour’s

²³³ Deleuze & Guattari conceptualise the wasp/orchid assemblage as forming a ‘rhizome’, which is taken from the botanical meaning of reproducing vegetatively through underground nodes and shoots to refer to an irreducible set of connections “comprised not of units but of dimensions, or rather directions in motion” (1980: 21).

(2005) actor-network theory and Latour's (1993) and Donna Haraway's (1991) explications of the hybrid concept, new descriptions of the world as comprising human-nature hybrids rather than natural *and* cultural objects *and* humans follow on the heels of the post-modern 'death' of nature as a concept and a set of discrete entities, although they equally affirm the perseverance of nature in seemingly cultural objects. Emphasis in these geographical and sociological works lies on the relational status of entities and the assemblages they make with other objects, people, and processes rather than on any materially essential properties that they may have. Human geographer Sarah Whatmore (2002: 117) situates animals, plants and other nonhuman things as "familiar co-habitants in the living fabrics of association". In a study of the 'relational ethics' of genetic modification, Whatmore traces the complex relation of domestication through the ubiquitous soybean and the centrality of its different properties in different domesticatory phases. From its nutritious and nitrogen-fixing capacities in peasant agriculture to its amenability to hybridisation and easy subsumption into corporate-led genetic engineering, the soybean is visualised as an "artefact of energetic relations between plants and people" (2002: 125). Its qualities, as become visible through these changing relationships, are 'agentic' – as are those of domesticates when viewed through the coevolutionary lens – contributing as much to agricultural developments as the concomitant economic and social circumstances, technologies and human determination.

Writing on people-plant interactions in private gardens as a site for relationship between two actors, Russell Hitchings (2003, 2004) argues that an environmental ethic ought to be 'performative', derived through observation of context-dependent relations rather than through the 'distant logical labours' of environmental philosophers. Hitchings' call for environmental ethics to be more grounded in the specificity of nonhuman encounters and "the complex ethical negotiations of lived lives" (2004: 4) is largely a criticism of its methodology, where Whatmore's (2002: 155-159) assessment of environmental ethics as wedded to the dualistic distinctions of nature and culture is a criticism of its ontology. Her view that the development of an inter-subjective ethics is not served by adherence to these categories is characteristic of the science and technology studies position, and comment on the shortcomings of the ontology employed by environmental ethics is also offered by geographer Noel Castree (2003a, 2003c, 2004). Castree is concerned not only about the continual use of dualisms but also the material essentialism that environmental philosophy reads into nature.

Castree (2003a: 3-4) critiques environmental ethics for presenting natural entities as having "a set of immutable properties that are relatively or absolutely autonomous from those of other entities and relatively enduring". That an elephant is a different social animal when it

is contained in a zoo than when it is free-ranging on the savannah is evidence of the contingent nature of nature's otherness, so that "relationally constituted, and situationally variable, members of any ethical constituency cannot be ontologically fixed once and for all" (p. 10). Castree's suggestion that "the motility and mutability of ostensibly environmental entities be recognised" (p. 3) in environmental ethics accords with the project of bringing domesticated nature into ethical consideration. It is unclear whether the perspectives of Castree and other post-humanists can be integrated into environmental philosophy or are, at core, antagonistic to the discipline. Even where radical concepts like hybridity are endorsed for not ignoring important issues about nature but "[offering] exciting new ways to take them seriously" (Castree 2004: 194), they may also represent a "fashionable preoccupation with breaking boundaries" (Plumwood 2001: 28) that has little to offer an ethic specifically concerned with the moral status and value of nature. Calls for the abandonment of the concept of nature in environmental philosophy altogether²³⁴ (Vogel 2002), or for a move to a 'post-environmental' ethic because the epithet 'environmental' is too problematic²³⁵ (Castree 2003a), may not be able to be absorbed by the discipline without bringing about its end. Certainly Plumwood's (2001: 25) defence of nature as a useful, although not uncomplicated, category is cautious of such moves: "the fact that a few people have begun to contest the devaluing and agentic disappearance of nature ... does not mean that we have arrived at a system of thought or life that can dispense with the concept". The challenge is to make room in environmental philosophy for the multiple 'agencies' of natural and cultural forces described in the science and technology literature, not at the expense of meaningful categories, but at the expense of static ontologies that are not sensitive to the effects of relationship.

The relevance of the post-humanist/post-environmental critique is also secured by the disruption of the ontological division of the world into human/nonhuman by the contemporary biotechnological context. One of the strengths of the science and technology studies perspective is its analysis of the genetic engineering of apparently new forms of life and its transgression of (constructed) natural and cultural boundaries. The ethical significance of biotechnology in this scholarship falls out of detailed descriptions of the social-economic-political-natural assemblages that the technology forms across a range of practices. The complex social element of the hybrid objects presented by science and

²³⁴ Steven Vogel's is a postnaturalist position that supports Bill McKibben's (1990) grounds for proclaiming the end of nature, questions the independent existence of nature, and ultimately rejects the idea of nature as too problematic.

²³⁵ "If those things we conventionally call 'environmental', 'natural' or 'non-human' in fact *exceed* those categories, ontologically speaking, then the question of who or what the ethics is for or about becomes very complicated indeed" (Castree 2003a: 10).

technology studies would appear to place this kind of analysis outside the traditional scope of environmental ethics. Even if the natural/social hybridity of the domesticate can be appreciated as generative and not diminutive of value, the 'other side' of the equation remains under-theorised: addressing the social context of environmental engagement is not a strength of environmental ethics as a whole, notwithstanding scholarship from politically-oriented ecofeminist writers. A previously criticised limitation of the field (Stephens 2000; Castree 2003c) is that it tends to use the one-dimensional language of the human/nature dualism – and this thesis is no exception – without delineating *which* humans and in *what* social circumstances. With this limitation acknowledged, and with political ecofeminist scholarship considered to sit at least partly within environmental ethics²³⁶, the conceptual resources for a relational critique of genetic engineering in the context of the coevolutionary domesticatory relationship are well within the ambit of the field.

Biotechnology and the relational ethic

This chapter has been concerned with three interrelated tasks. The first was to describe domestication in relational, evolutionary and ecological terms in order to rescue domesticates from their subaltern moral status in environmental ethics. The second was to make the otherness of domesticated nature visible and defensible. The third, undertaken here, is to draw on this reconceptualisation of domestication as a coevolutionary relationship with the otherness of nature as a basis from which to judge biotechnological interventions.

Under the positive articulation of domestication, does genetic engineering represent the end of the coevolutionary relationship to the extent that the change it effects is no longer strictly evolutionary? If the significant feature of evolution is taken to be indeterminacy²³⁷, then the loss of the expansive potentialities and possibilities from the technology's overdetermination of future forms does seem to remove biotechnological domestication somewhat from the evolutionary process. Its capacity to create transgenic organisms that could never have evolved naturally²³⁸ may also disqualify its products from evolution proper. However, the biotechnological domesticate has not necessarily ceased to be evolutionary. It has still been descended from intact whole organisms through evolutionary

²³⁶ Ecofeminist ethics tend to be nested within critical analyses of power relations (Hay 2002), and gender politics have been a strong point of debate between ecofeminists and deep ecologists in the past (see Salleh 1984, 1992, 1993, 2000). At least one current site of common ground between ecofeminist and deontological scholarship is the ecological narrative approach they both take in conceptualising and articulating ethical relations (Preston 2001).

²³⁷ As was argued in Chapter Six (pp. 194-196).

²³⁸ As discussed in Chapter Five, this form of argumentation is problematic as the loss of ecological function selected for under domestication could never have gained a foothold in wild populations.

time, unlike new synthetic organisms that are assembled as properties and are entirely removed from an embodied evolutionary process (Preston 2008). The oft-repeated argument that change is the defining feature of evolution has been used to argue that the crossing of species barriers in the creation of transgenic organisms is as evolutionary as speciation itself. The attendant point that species themselves are so difficult to define that they may be considered as not definitively existing makes such changes even less devious. But this is merely an iteration of the argument about the unnaturalness of biotechnology, which has already been overdone. Coevolution is not just a variant synonym for evolution. It is a much broader interpretive framework that is concerned with emphasising mutual affect and the quality of the domesticatory relationship. To revisit the biotechnological question with this in mind responds to the query as to what makes our inter-specific relationships ‘authentic’ (Acampora 2004) with the ideal of a domesticatory relationship that is other-acknowledging.

The other has its own ‘autonomous space of meaning’, its own purpose, its own *telos*. It is “an independent centre of needs and originator of projects that may demand our respect and constrain our choices” (Plumwood 1998a: 398). Thus, a measure of biotechnology is whether the application of genetic engineering techniques to plant breeding has a diminutive impact on the other’s autonomous space of meaning, and whether this affect is more pronounced than in traditional domestication. This appears similar to the question of whether the use of biotechnology to produce some astrophel equates to the transformation of a natural entity into a biotic artefact. Does the biotechnological production of nature result in the loss of the ontological category of autonomous nature (Lee 1999) (to the extent that domesticated nature qualifies as such)? Does it eliminate the other? Not entirely. Not at all if the concept of otherness employed refers simply to the unknowable lived experience of a nonhuman organism. However, if otherness refers not only to the perspective, but also to the existence and performance of the independent, endogenetic aims of the organism, then its modification can be minorative. Its own ‘space of meaning’ becomes dominated by the ‘human space of meaning’: “[t]he more intrusive our human meaning system is, whether it uses gene technology or traditional breeding, the more are our meanings introduced into the organization of the plant organism” (Rehmann-Sutter 2001: 19-10). Already a hybrid of human and plant intentionalities, already a partially narcissistic object, the ‘becoming human’ plant becomes over-determined by human meaning.

Although the coevolutionary framework is not concerned with identifying and protecting strict material boundaries against particular interventions on the basis of their previous imperviousness (an argument that has already proven easily dispensed with under the rubric of the fact of change), the molecular method of genetic engineering does transgress a significant boundary. Domestication can be described as collaborative in three ways. The

first is that the domesticated form is an embodiment of a confluence of human desires and diachronic botanical conformations. The second is that this form is concausal. It has been created through a collaborative *process* between human and the other, a to and fro conversation between the breeder and the opportunities and constraints inherent in the plant. It is through the plant's coherence as a reproducing, evolving, biological entity that it can be said to be participating in the relationship. Bypassing the reproductive process through the use of the recombinant DNA technique does not eliminate the otherness of the other, but it certainly ends our conversation with it. The other can no longer be said to be a participating subject. On these grounds, the technology is coercive rather than collaborative.

Thus, the third sense of collaboration is epistemological; it relates to the way we *elect* to encounter the other. The Buberian I-You orientation that knows the other as a fellow subject is the basis of any meaningful relationship (Buber 1970). The I-It approach offers only an experience of the other as an object; it is not a relationship proper. The application of Buber's philosophy of dialogue to human-nature relationships sees the I-It orientation as a variant of the technological enframing of nature as 'standing resource' described by Heidegger (Lim 2001). Biotechnology, in its foreclosure of the subjectivity of the other, and its conceptual and material reduction of whole living organisms to an aggregate of genetic material²³⁹, is an I-It relation. It encounters the other in terms of the other's capacity to be utilised as resources. The problem with the I-It orientation is that it only reveals a world of objects. Neil Evernden (1985) likens the I-It way of knowing to the predator's gaze. A predator will stare fixedly at its prey, refusing kinship with it, singling it out as an object, depriving it of its subjectivity. In the wild, this stare is adopted only for a short while – it is a situational, transitory state – but in human-nature relations it has been institutionalised through established ways of knowing and acting that, in turn, have informed the development of particular technological solutions.

A relational approach is strongly anthropological, in that it is concerned with what being human is or ought to be. A key value of other-acknowledging relationships identified in deep ecological approaches is that they are necessary for the full realisation of the human self. Apprehending nature as an 'It' creates a denuded world, a world of objects (Evernden 1985) and this is a diminution of people's experience of both themselves and the world: "[w]hen we say 'It' to the world, both we and the world are changed. This is reversible if we can learn to say 'You' instead" (Evernden 1985: 134). Knowing the world as a You means being open to recognising the other's autonomous space of meaning and its potential for intentionality, even in the absence of it meeting any traditional criteria for intentionality

²³⁹ As discussed in Chapter Two (p. 72).

(Plumwood 2002). People gain benefits in adopting an I-You approach to nature and living in a world of subjects. The mode of our engagement with domesticated nature changes and shapes us just as it changes and shapes the plants. This focus on the human side of the relationship has commonalities with environmental virtue ethics and its critique of biotechnology practice on the basis that it runs contrary to certain human dispositions that are better for humans and for nature. The concern is the environmental virtue of the person who would engage in or endorse biotechnological interventions. Both the relational and the virtue approach reject an excessively instrumental stance toward nature, at least partly on the grounds that the I-It relation ultimately diminishes us. In this respect, the relational account of domestication represents a progression of previous, non-specific environmental ethics arguments that excessive instrumentalisation of nature is the ethical problem of biotechnology. It does not preclude the instrumental use of nature, but it does counsel the rejection of an excessively instrumental stance, and, further, the adoption of an appreciative one (Rehmann-Sutter 2001).

The framing of the responsiveness of plants to domestication as a kind of generosity holds within it the corresponding concept of appreciation. The basis for an appreciation of domesticates is not unlike the argument that we ought to feel gratitude for the life-giving ecological services of nature²⁴⁰ (Plumwood 2001; Kumar & Kumar 2008). They give us life, increasing food yields, new flavours, colours and forms, and their adaptiveness to new environments has allowed us to take them wherever we go. An appreciative mode recognises both the abundance and latitude already given by domesticates, and that which could be given in the future. For instance, yields can continue to increase with attention to good soil health, organic fertilisers, and intensive polycultural planting systems (Wolfe 2003). Traditional breeding can generate ‘horizontal’ broad spectrum pest resistance, rather than refrangible ‘vertical’, single gene protection from Mendelian breeding and biotechnology (Cleveland *et al.* 1994; Robinson 1996). Biotechnology is not the only way to achieve yield increase; its pursuit as a solution is a reflection of the research priorities of the agricultural sciences, which are strongly corporate-driven. A recognition of the generosity and excessiveness of the domesticatory relationship is further precluded by one of the strongest legitimating arguments for biotechnology: the alleviation of world hunger. This argument is an effective trivialiser of concerns about coercive relations with nature because the ethic of alleviating human suffering (which, in anthropocentric hegemony, can range from people not having enough food to producers not having enough income (see George

²⁴⁰ One way into the appreciative mode is through the recognition of our fundamental reliance on domesticated plants: “[t]he appreciative mode changes immediately if we know that without plants we will not survive” (Rehmann-Sutter 2001: 9).

1986; Shiva 2000b) that traditionally outweighs the ethic of caring for nature is even more pronounced when the two are so clearly at odds (Vanderheiden 2006). The counter argument that food shortages are not caused by the lack of food *per se*, but by the lack of income that additional yields could ameliorate through the export market, also retains the vision of the domesticate as generous, and deserving of appreciation. Indeed, the excesses of domestication are almost parodied in the global overproduction of crops and the massive food wastages of industrialised countries (see Bowring 2002). The hunger argument exemplifies the non-appreciative mode when it represents the inequitable distribution of food through the market as a miserliness of domesticated nature.

However, the relevant query is whether genetic engineering relates in an appreciative way to domesticated plants as intact embodied others. As an exemplar I-It relationship, it does not; however, as has been soritically argued in defence of biotechnology, neither do many other domesticatory interventions. The gene transfer objectives of Mendelian plant breeding, or the use of mutating chemicals and radiation to induce genetic variation, even the determined efforts of pre-Mendelian domestication to affect desired change in plant forms, may have been constrained by the inherent characteristics of plants and the extent of scientific knowledge and technical acumen, but otherness was a persistent rather than consciously appreciated quality. Technology has long done the work of enframing nature as resource. Genetic engineering is not exceptional in this respect; it is its unique technical and political characteristics that give its I-It orientation a new significance. The insertion of genetic material into the cell nucleus silences the I-You domesticatory conversation that relied on plants participating as intact biological beings in their own evolution. It represents a “severing of the vocal chords of nature”²⁴¹ (Evernden 1985: 14). Further, by not only conceptualising but actually making genes interchangeable units, genetic engineering effectively enframes *all* of living nature as standing resource. These are other-denying characteristics that are particular to the technology, but it is the broader social, economic and political contexts of biotechnology, overviewed in Chapter One, that ensure the consolidation of the I-It orientation.

Critical appraisals of the introduction of biotechnology into agriculture identify a number of factors that ensure the relatively unconstrained expansion of genetic engineering technology to the detriment of other domesticatory approaches. The oligopolistic biotechnology industry consolidates seed, agrichemical and biotechnological interests into large global corporations that routinely acquire each other and smaller companies. A political economy

²⁴¹ In reference to the vivisectionist practice of severing the vocal chords of animals so that practitioners could dissect them without intrusive reminder of their subjectivity (Evernden 1985).

of allegiances between governments and the industry has seen the establishment of permissive regulatory systems and a cross-sectoral approach to promotional strategies. In the context of increasing industry-university collaboration, the corporate profit-driven agenda dominates agricultural research and development priorities, and has facilitated the expanding privatisation of domesticated products through worldwide intellectual property regimes. Unprecedented exclusionary rights over food seed precludes traditional seed saving and replanting and has seen the commercial abandonment of non-patentable varieties, while the agronomic spread of wind-borne patented seed opens neighbouring farmers to legal action, organic farmers to the loss of their certification, and secures a market ubiquity of biotechnological seed that makes segregation and labelling redundant. Persistently disadvantageous terms of trade place market pressure on developing nations to adopt higher yielding genetically engineered crops, while developed nations take up the technology in the context of long-standing economic demands for (over)production.

The technological capacity to resource genes from any organism removes the institutional need to preserve their organismic, agroecological and community context in favour of their collection and storage in *ex situ* gene banks. Biotechnological solutions uphold the general tenet of agricultural efficiency as the reduction of labour input through mechanised large-acreage enterprise, which is strongly tied to a progress narrative of releasing the overwhelming majority of people from the toil of food provisioning labour for higher pursuits. In intensifying this reduction in a way that is broadly characteristic of neoliberal globalisation, it further diminishes opportunities for people to participate in meaningful restorative agricultural relationships. In short, biotechnology shuts down agricultural and domesticatory alternatives in an ongoing way.

A relational critique of biotechnology does not favour the *status quo* by default. It is simultaneously an appeal for models of domestication and agricultural production that acknowledge the other and recapture the I-You orientation of coevolutionary relationship. The market growth in organic, locally produced foods that accompanies the consumer rejection of genetically engineered foods demonstrates this point. As argued in Chapter Two, the moral dimensions of twentieth century ways of relating to nature through domesticatory practices in service to large-scale industrial agriculture have become more visible and meaningful in the context of biotechnology. The excessive instrumentality of genetic engineering represents a moral limit to this relationship. It is a ratcheted shift toward a totalising enframing of nature as resource, just as it embeds a non-appreciative I-It stance as the available way to orient ourselves to those organisms with which we are most ecologically intimate.

Conclusion

This chapter aimed to offer a positive articulation of domestication that can provide a framework for assessing the ethical import of biotechnological interventions. It has done this by directing attention to the relationship of domestication rather than continuing a focus on the ontological or axiological status of its participants. The previous chapter showed how the quality of wildness and its positive natural value persists in domesticated nature in a number of forms, most instructively as the otherness of nature. The significance of this recognition is that, while otherness is concerned with the autonomous workings and experience of the nonhuman entity, it is necessarily a relational property. By definition, it requires (human) selves to be 'other' to, and consideration of its ethical implications in environmental ethics scholarship has required explication of the quality and orientation of the resultant self/other relationship. The identification of retained wildness *qua* otherness in domesticates introduces relational terms into thinking about domestication, and respect for the wild qualities of domesticated nature is central to a reconsideration of the traditional understanding of domestication as a one-way process of domination.

A reconceptualisation of the relational aspects of domestication is supported by three additional factors. First, there is a growing recognition within environmental ethics that the field ought to provide a more positive conception of the human relationship with nature. Second, the contemporary context of biotechnology has reframed the products and the processes of conventional domestication as (relatively) natural and acceptable. The criticism that biotechnology entails an excessively instrumental and dominating relationship with nature places attention on the extent to which domination has characterised previous domesticatory practices. Third, recent scholarship in archaeological and archaeobotanical fields has interpreted the dynamics of early and ongoing domestication through the lens of the evolutionary and ecological sciences. This scholarship supplants outdated models of domestication as a cultural triumph that have informed environmental ethics understandings of domestication, and firmly situates domestication within an explanatory framework of people-plant coevolution. This allows a re-evaluation of domestication as necessarily minorative, the construction of a positive appreciation of human domesticatory interference in nature, and a new vantage point from which to consider popular deontological objections to biotechnology.

Descriptions of domesticatory history in ecological and evolutionary terms provide a critique of the nature/culture split and the traditional ethical discontinuity between wild and domesticated nature. By regarding plants and humans with a measure of equivalence, the coevolutionary account of domestication provides a way into an appreciation of the otherness of domesticated plants. Adopting the coevolutionary approach to domestication is

an exercise in acknowledging alterity. It provides an account of plants' 'perspective' of domestication by emphasising the ecological benefits of domestication for domesticates, and inverting the story of colonial expansion as one of plants recruiting people to spread and proliferate their populations. The reciprocal structure of the domesticatory relationship requires humans to adapt to the very particular ways that these plants exist in the world, just as plants adapt to their human selectors. The coevolutionary account gives attention to the primary role played by the botanical form of plants in directing domesticatory practices and traces the unrecognised effect that plants and domestication has, in turn, had upon humans and human activities. The dynamics of coevolution are inherently relational, and the products of coevolution are inherently collaborative: two parties are engaged in an actual, material relationship, both gain benefits from the association, and both have causal power in the direction and outcome of the exchange. Thus the domesticate is a hybrid of intentionalities; a (partial) botanical manifestation of human choices and desires. Such a collaborative account of the production of natural entities is also strongly advanced in post-humanist ontologies that give precedence to forms of relationships over the properties of their constituent entities. This scholarship explicitly and implicitly poses a challenge to the accepted boundaries and objectives of environmental ethics, and offer the field important resources for further development of the collaborative account.

A relational, coevolutionary, collaborative description of domestication provides a basis for assessing the ethics of biotechnological intervention. It is not concerned with proving the existence of intrinsic value, but with constructing human relationships with the other as though nature were intrinsically valuable. Otherness is encountered in domesticatory practice primarily as the botanical and biological means through which domesticates engage and 'converse' with humans in their own production. The quality that makes the domesticatory relationship 'authentic' is respect for the other's attributes, particularities, and their means of maintaining them. Objections to the biotechnological breaching of biological barriers to reproduction are understandable in terms of showing disrespect to otherness and the boundaries through which it this otherness is maintained. In a collaborative mode, the domesticated other is not encountered only as a resource, but also as a subject (albeit attenuated). Biotechnology is a compulsion rather than a collaboration; it encounters the other as an 'It' and not as a 'You'. The relational approach thus upholds and strengthens previous environmental ethics identifications of excessive instrumentalism as the core problem of biotechnology. Genetic engineering is further distinguished from other contemporaneous and previous coercive agricultural techniques by its politico-economic context, its growing ubiquity, and its foreclosure of alternatives, thus assuring a commitment to an I-It orientation toward the domesticatory relationship into the future.

Conclusion

Domestication, biotechnology and the *domus*

Dualistic frameworks that cleanly partition nature from culture, and wild from domesticated, ultimately falter on biotechnological questions. Attempts to understand popular concerns about biotechnology in terms of the rhetoric of unnaturalness encounter the ambiguous and sometimes contradictory meanings of natural and unnatural, and the particular difficulty of definitively assigning domesticated nature to either category. The refinement of the natural/unnatural split into the nature/artefact division appears more instructive at the outset. Discourses of artefactuality establish the natural value of evolutionary and biological processes that are independent of human interference, and even provide for a systematic gradation from naturalness to artefactuality that can account for the undesirability of genetic engineering without dispensing with the domesticate. Yet the nature/artefact division still demands the purity of its categories: once it is determined by any given set of criteria that nature has been transformed into artefact, it no longer qualifies for moral consideration under an environmental ethic.

The nature/artefact distinction also falls short because it cannot account for the contribution of the living organisms to their own domestication. There is a wildness within domesticated plants that strongly mediates the role of intentional human design in the emergence of the *domestikationssyndrom* and subsequent domesticated traits. It also lays challenge to the certainty of the wild/domesticated dualism that is at the core of the traditional exclusion of domesticated nature from the scope of environmental ethics. The seemingly straightforward category distinction of wild/domesticated is disrupted by the retention of wild traits and qualities in domesticated nature, and by scholarship from within the field that recognises the limitations of an ethic that cannot offer any positive conception of modern human activity. Each of the binaries that have been employed to understand domestication and biotechnology are derived from the nature/culture dualism, which is conceptually limited in its capacity to provide a compelling description of the world. Nature is not at an end because it has been affected by culture, any more than culture is at an end where it is infiltrated by nature.

That said, moving beyond dualistic approaches to understanding human-nature interactions is not easy. Tracing the material imbrication of wild within domesticated nature, qualifying the designation 'artefact' with the prefix 'biological-cultural', or presenting narratives that

foreground the alterity of nonhuman others, are not radical revisions in comparison to the new 'hybrid ontologies'. However, the goal is not to dispense with meaningful descriptors but to further develop, through synthesis with relevant scholarship, the existing conceptual resources of the field of environmental ethics. The boundary lines of familiar ontological categories have simply been reconsidered and redrawn to bring attention to the extent of their coexistence, and to capture the obdurate naturalness of ostensibly cultural entities.

Contra its severe dualistic framing as a source of disvalue, the domesticate is not a diminished, degraded, adulterated specimen that no longer qualifies as nature. It is an evolutionarily embedded organism, with distinctive botanical characteristics that direct the particularity of its biologically autonomous workings. It is an other, and not simply in the basic sense of being a nonhuman. The wild otherness and other wildness of domesticated nature is folded through its history, materiality and processes of becoming. By virtue of its diachronic capacities to develop, grow and reproduce, to initiate change or to maintain stasis, the domesticated organism provides its own force of generation and motion, and so possesses Aristotelian internality. It is a teleological centre of life with its own state of well-being, or 'good', that can be advanced or hindered by human interferences. The nature of this good is determined by species-specific characteristics, while the maintenance of this good is the teleology, or *telos*, towards which all autonomous biophysical attributes of domesticates are directed. In short, the domesticated plant is a responsive, biologically independent entity working to fulfil its own unique ends.

Its botanical particularities can be traced backwards to the biological function they serve (evolutionarily speaking), and forwards to the effect that they have on the organism with which the domesticate is most ecologically intimate. Domesticated plants are both affected and affective: the sweetness of fruit off the tree, the pliability of grain when pulped, the culinary appeal of the latest iteration of the *Brassica* family, all motivate people to protect domesticated plants, and customise breeding and agricultural practices to their specific botanical features and agronomic needs. In their relationship with humans, domesticates provide a generosity of yields, diverse flavours, appealing colours and textures. Their biological function coincides with their biological teleofunction: the characteristics that have evolved under natural and artificial selection are the same ones that ensure their ongoing protection and proliferation by their 'primary dispersal agents'. The full range of contemporary gastronomic life supervenes on this concurrence.

This description of the domesticate as a cohesive organism matches the natural world as it is encountered in the world of appearances. While the language of plant genetic resources belongs to specialists, biotechnologists and the world of institutionalised breeding and conservation, the organism is the level at which domesticates are conceptualised by ordinary

people in everyday life. The technical capacities of genetic engineering reconfigure the organism in the popular imagination to match a reductionist account of the natural world as an aggregate of genetic resources. Thus, objections to biotechnology in part stand as a protest against the loss of the perceptible, tactile domesticate, with all its embodied, particularised and affective qualities.

However, the primary argument through which genetic engineering is differentiated from conventional domestication has been *via* the use of evolutionary history as a standard against which to judge anthropogenic change. In wider debates about biotechnology, this argument is used to sustain positive representations of genetic engineering, in which the similarities between the gene transfer technique of genetic engineering, the directed breeding of conventional domestication, and the mechanisms of natural evolution are strongly emphasised. While these associations serve a distinctly political purpose for proponents of biotechnology, they are also shown to be prominent in environmental ethics assessments of the ethical import of genetic engineering. In both these approaches, natural evolutionary change is taken as the legitimising basis for anthropogenic change, and previous anthropogenic change as the precedent for current and future changes. Notwithstanding the strong reliance of similarity discourses on a teleological interpretation of chronological events, and the assumption that if a distinction between two things is not easy to make then no significant distinction exists, the key limitation of this approach is that much of the continuity between biotechnology, domestication and evolution relates to the question of breaching natural boundaries. Too much comes to rest on the veracity of deontological objections to the breaching of species boundaries, the certainty of species categorisations, and the moral consequence of the mutability of species over evolutionary time. These arguments take the incidence of change *per se* as the prominent ethical quality of evolution and tend to miss other ways that evolutionary history, and species integrity, could be morally relevant.

There are at least two ways that consideration of evolutionary history provides a point of differentiation between biotechnology and domestication, both of which derive value from the autonomy and wild processes of nature. The first is through the evolutionary quality of indeterminacy that is characteristic of the threefold process of evolutionary process: the random generation of variation; the natural selection of organisms that best 'fit' into their environment; and the transmission of the most successful traits to the next generation through heredity. That the outcomes of evolution cannot be foreseen is the other side of the coin to recognising the limits of human intentionality in domestication. Indeterminacy is the kind of wildness that keeps us from living in a narcissistic world that is only of our own

making. It is this quality that is endangered by the over-determinism of domesticated forms made possible by the genetic engineering technique.

The second evolutionary paradigm that is passed over in standard appeals to evolutionary history for legitimacy of biotechnological interventions is that of the animal/plant coevolutionary relationship. This evolutionary ecology perspective of domestication as the interdependent – albeit asymmetrical – evolution of two groups of closely associated organisms is a definitive move away from descriptions of agriculture and domestication as the triumph of culture over nature. It preserves the situated otherness of plants as partial agents of their own evolution under domestication. This is not about granting equal ethical weight to plants and people, but is about the benefits of making their alterity visible so as to understand domestication as a mutual engagement between two ‘subjects’. It is here that we come back to what could be important about species. Reproductive barriers are mechanisms through which an organism develops and maintains its species-specific characteristics over generations. These boundaries are inviolable but rather constitute a set of opportunities and constraints that maintain the otherness of an organism. It is through these that they can be said to be participating in the two-way ‘conversation’ of domestication.

The normative ideal of domestication in its standard comparison with evolutionary history is limited to the fact of genetic change. The coevolutionary account, on the other hand, sets forth an ideal of domestication as a potentially collaborative relationship, which values the involvement of people and the contributions of plants, and entails a degree of engagement with nature that is *on par* with the kind of agricultural ideals offered by environmental virtue ethics, agricultural aesthetics and ecofeminist literature. These ideals require the vested participation of farmers and breeders, and are necessarily linked to the politics of who carries out the tactile labours of farming and breeding, and in service to what model of agricultural production. Framing domestication as a mutually affective process opens the definition out to include the ways that humans have both produced and been produced by domestication. It allows consideration of the kinds of social, economic and political elements that would not traditionally fall within the scope of environmental ethics. (Ecofeminism’s ‘subsistence perspective’ places value on the meaningful and diverse agricultural labours that mediate nature for the reproduction of everyday life, but this reconceptualisation of ‘the good life’ is an integral element of the ecofeminist critique of global capitalism). As biotechnology debates are reinvigorated in the context of the European food crisis and the predicted effects of climate change on agricultural productivity, the twin legitimating arguments of hunger and sustainability are again being mobilised by biotechnology proponents, to great effect (Erlanger 2008; Pollack 2008). A rejection of biotechnological solutions in agriculture on behalf of the natural value of

domesticated nature benefits from a critical analysis of the corporate arrangements coextensive with biotechnology and its dominant mode of agricultural production and trade, not least because such an analysis provides direction on activist strategies to protect domesticated nature, its diversity, and its continued evolution – outside of its service to contrived market needs and at the local level of the *domus*.

Strategies for safeguarding the traditional domesticate through local and household horticulture and agriculture are central to third world politics of *in situ* conservation and the protection of polycultural, community-based agricultural systems. Their appeal is also evident in the growth of local organic food markets in the First world, but are more pointedly seen in the household pursuit of the environmental virtue of simplicity *via* the incorporation of domesticated food plants into private domesticated spaces. There are possibilities here for deepening studies that trace people-plant collaborations in ornamental gardens with a consideration of the politics of household food production, and the mutual affectivity of coevolutionary relationship.

Bringing the domesticate into the *domus* is one way to circumvent the instrumental rationality of large-scale, highly-technologised human interventions in nature. The level of human control over the form and function of organisms increases considerably with genetic engineering technology but, ethically speaking, it is our attitude to nature that matters. Our instrumental uses of nature need not spell the domination of nature. However, from Taylor's exclusion of the bioculture from moral consideration to Shepard's cosmology of agriculture as a minorative descent, the argument that domestication is necessarily a domination (and that this is the primary source of its disvalue) has been a recurring theme in environmental ethics. In the context of biotechnology, this categorisation has had to be qualified; it is the excessiveness of the instrumentalism in gene technology that poses the problem.

Domestication, even in the positive conceptualisation presented in this thesis, is a humanising process that manifests aspects of human meaning into the very botanical nature of plants (and the biophysicality of animals). Where this leaves off from being collaborative and becomes a relation of domination depends on whether our mode of orientation affords respect for the otherness of nature. Certain technological capacities can short-circuit this ethical process. It is with regard to the loss of the other through the over-determination of natural entities with human meaning that Neil Evernden (1992: 120) speaks of gene technology as representing the domestication of nature "in body, in concept, and finally, one must say, in spirit". The challenge is to engage in constrained forms of instrumental use of nature so as not to bring about its total domestication. The wild otherness that gives nature its value as an independent entity is the necessary element of a rich and meaningful world that is not of our own making. It ought to be preserved in our domesticatory dealings.

Environmental ethics, from its beginnings as a discrete discipline concerned with articulating sound philosophical reasons for the protection of wild places, has begun to widen its scope to include restored nature and nature that persists in urban settings. The account provided here of the ways in which domesticated nature can also be regarded as possessing positive natural value is a preliminary contribution that intends to stimulate discussion on the environmental ethics of domestication and further scholarship on the recognition of less-than-wild nature.

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Appendices

Appendix One

Asilomar

The recombinant-DNA technique was successfully performed in 1973 with the creation of a modified *E. coli* bacterium by Stanley Cohen and Herbert Boyer, and began to be used with frequency on micro-organisms internationally. Some of these experiments were conducted using potentially dangerous bacterial forms, yet there existed no clear guidelines or restrictions on such research. Safety concerns were raised by key bioresearchers and, in late 1974, a short-term voluntary moratorium on certain types of genetic engineering research was called. In February 1975, a 140-strong group of biologists (mostly North American) and a scattering of journalists, physicians, and lawyers, convened at the Asilomar conference centre in California to examine the basis of these safety concerns and to determine future regulatory mechanisms for genetic engineering research. Remembered simply as 'Asilomar', this conference was a landmark event that set the terms of the genetic engineering debate as being neither political nor social, but solely concerned with resolving the purely technical issue of containing risk (Wright 2001; Hindmarsh & Gottweis 2005).

Recognising the potential for public controversy in the highly politicised environment of the 1970s, the key goal of the organisers was to resolve safety and regulatory issues without invoking either public debate or government intervention through legislation or stringent oversight. Although scientific institutions and corporations expected that large-scale commercialisation in the fields of agriculture, biological warfare and medicine would eventuate, due consideration of the possible ethical and social ramifications of the new gene technology was excluded from the agenda (Wright 2001). The bulk of the participants were scientists in the field, and so were understandably focused on identifying and resolving the occupational and environmental safety aspects of their research rather than addressing broader political issues that clearly lay outside their expertise. When it came to determining the form that future regulation of the science of genetic engineering would take, these same participants were, also understandably, intent on avoiding what they saw as unnecessary intervention in their research by regulatory bodies. There were no representatives from the scientific fields of ecology or evolution, the disciplines of social science or ethics, or even public interest groups. The regulatory form to emerge from Asilomar was indeed self-regulation in line with agreed-upon guidelines and laboratory procedures. The absence of consideration for the social aspects of the research in the agenda and the narrow expertise of

the participants were, according to historian Susan Wright (2001: 240), “essential to the goal of self-governance”.

Self-governance was endorsed by participants and accepted by governments as the legitimate form of regulation for a number of reasons. First, the issues of safety that were initially raised by researchers were essentially concerns about the stringency of laboratory practices in protecting worker health and preventing the accidental release of hazardous micro-organisms into the environment. In this sense, the risks of genetic engineering were understood as purely technical concerns; laboratory hazards were tangible and could be mitigated by the adoption of best practice procedures. A key outcome of Asilomar was the agreement among researchers to use a weakened strain of *E.coli* in laboratory experiments to decrease the risk of harm if accidental release did occur. These disarmed bacteria, said to be unable to survive outside the artificial conditions of the laboratory, were effective in allaying public fears of environmental disaster and, perhaps more importantly, in proving both the efficacy of the technical solution and the legitimacy of scientists as regulators. Second, Asilomar was and still is seen as a positive example of the scientific community pro-actively identifying and managing the potential risks of their work (Frederickson 2000). Calling a moratorium on genetic experiments until a sound regulatory framework was in place demonstrated a welcome level of social responsibility and framed the participants as a unified community whose recommendations were supported by uncontested scientific knowledge. Although there was considerable difference of opinion within the conference – with some biologists impatient to renew their research and arguing against the need for any safety interventions – one of its most significant outcomes was the creation of a unified group (Wright 2001). This unity underscored another effect of establishing a framework of self-governance, where attendance at Asilomar automatically granted participants the status of experts – not only in the field of genetic engineering, but also in its proper regulation (Gottweis 2005).

The legitimacy of this group in defining the scope of the dangers, and then self-managing them, was also supported by the atmosphere of a greater level of public trust in regulatory science than is observed today. Public confidence in a value-neutral science to both define and resolve problems had been negatively affected during the era of Carson’s *Silent Spring*, but was not yet diminished by either scepticism of the too-frequent mobilisation of science in the service of entrenched commercial interests or by direct experience of its failings. That the Asilomar scientists were seen to be exercising restraint by holding off their experiments until risks could be accounted for helped to neutralise calls for greater public participation in decision-making about this new technology. The spirit and language of Asilomar was one of progress – the benefits to be gained from genetic engineering were made concrete, real and

achievable, while the hazards were instead described as only 'potential' (Wright 2001). The collapse of all possible risks into the scientific resolution of a technical problem by socially responsible experts in order to realise enormous benefits established the Asilomar participants as legitimate regulators and worked to legitimise the technology as a whole. Wright describes Asilomar as "an effort on the part of the organisers to create an ideology to support the development of a field that promised to be socially disruptive" (2001: 236). Certainly, the primary legacy of Asilomar is the reduction of the regulatory scope to the scientific management of scientifically provable risk. Even though regulation of the technology has moved well beyond the confinement of its products to the laboratory, and into the management of their deliberate environmental releases, the 'containment' focus established at Asilomar remains the primary risk management strategy. The US and Australia have largely followed the Asilomar 'style' and even though New Zealand has been more inclusive of public participation in its regulation of genetic engineering, non-scientific input remains marginalised (Rogers-Hayden 2005). The last 15 years have seen the EU deviate from regulatory systems where the definition and resolution of valid concerns relies solely on scientific expertise, to a more democratic model that defines risk as a social rather than solely technical concept (Abels 2005). Beyond the impact of considering social, political and even moral issues in the regulation of genetically engineered organisms on transatlantic food trade, Europe's regulatory system faces limitations of its own.